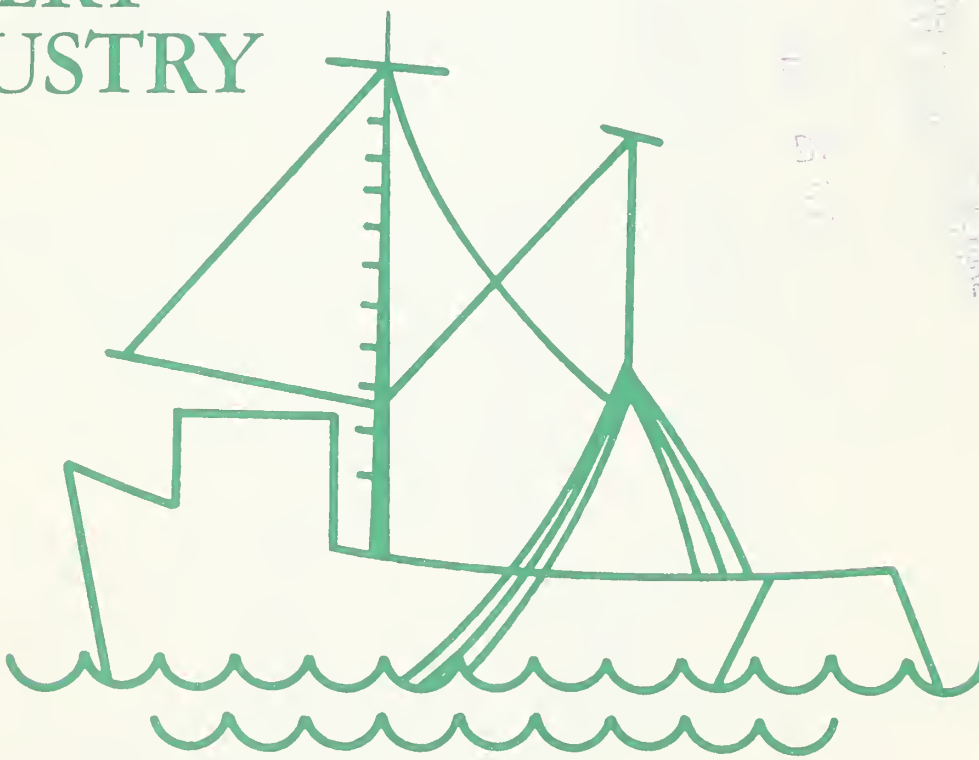
FDD FIELD REPORT 45
JULY 1974

DEMAND AND SUPPLY POTENTIALS FOR SOUTH VIETNAM'S FISHERY INDUSTRY



International Development Center • Economic Research Service
U.S. Department of Agriculture cooperating with U.S. Agency for International Development
and the Vietnam Ministry of Agriculture and Land Development

Demand and Supply Potentials for Vietnam's Fishery Industry

ABSTRACT

Vietnam's effort to increase fish exports, foreign exchange, employment, and income is hampered by industry conditions at home. Penetration of growing Asian fish markets by Vietnam depends on its ability to increase the aggregate catch at lower total cost. The industry's profits must be improved, domestic fish needs met, and the marketing system improved.

Additional stocks of 600,000 to 850,000 metric tons (M.T.) of demersal and pelagic fish seem to be available to Vietnam and other nations in international waters adjacent to Vietnam. Adding 200 medium size boats to the present fleet of 2,200 boats over 20 gross metric tons (G.M.T.) could expand total production 150,000 M.T. by 1980 with basic improvements in technology and about $30 million additional capital.

Required improvements in the fishery industry include: 1) increased production per trip and per year; 2) change to single trawling and diversified gear; 3) policy changes to encourage use of navigation charts, marine compasses, radio communication, and electronic fish locators; 4) reduced operational cost per kg of fish caught; and 5) improved fish collection and distribution systems. Only if these are accomplished can the industry expand profitably. It must expand rapidly by 1980 if estimated domestic fish needs of 800,000 M.T. are to be met and supplies are to be made available for export.

Key Words: South Vietnam, fish, developing country, exports, production, marketing, technical assistance

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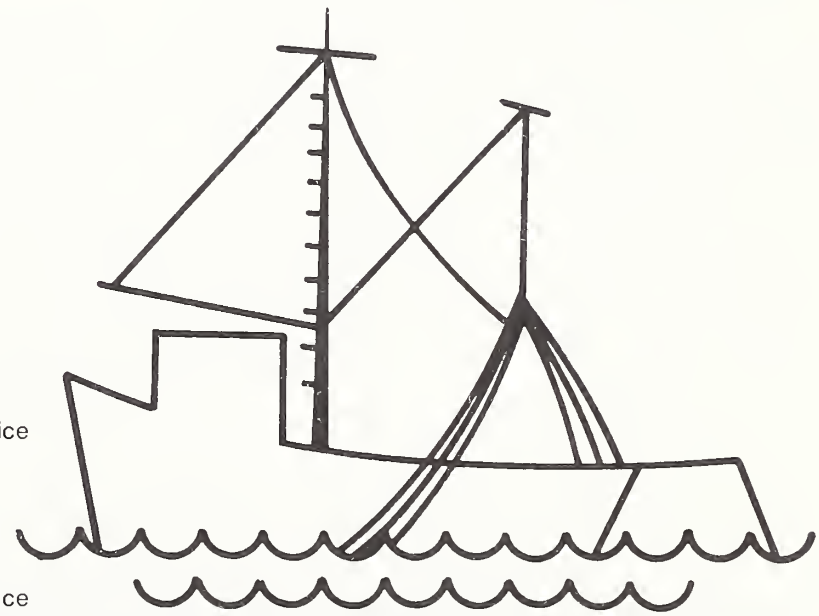

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PREFACE

This is the third and final report on Vietnam's fishery industry resulting from studies conducted by the Economic Research Service (ERS), United States Department of Agriculture (USDA). The research was in cooperation with the United States Agency for International Development (USAID) and Vietnam's Ministry of Agriculture and Land Development. The first two publications dealt with export opportunities for selected Vietnamese fish products in Asian markets,1/ and this one summarizes highlights from these earlier reports and then details Vietnam's domestic fish needs and it's fishery industry supply capability, costs, profitability, and marketing structure.2/

Overall leadership for the fishery industry studies was provided by Howard L. Steele, International Development Center, Foreign Development Division, ERS/USDA. Harlan C. Lampe, under personal service contract to the Center from the Department of Resource Economics, University of Rhode Island, was responsible for the industry supply, costs, profitability, and marketing structure phases. Robert D. Niehaus, also of the Center, and Steele were responsible for the export and domestic demand phases of the study. All three authors collaborated on policy sections. William S. Hoofnagle, ERS/USDA, was overall coordinator for this and similar export studies concerning Vietnam's forestry and agricultural crops industries.

1/ See Demand for Selected Vietnam Fish Products in Singapore, ERS FDD Field Report 31, USDA cooperating with USAID, May 1973, and Export Opportunities for Selected Vietnam Fish Products in Japan, ERS FDD Field Report 43, USDA cooperating with USAID, January 1974.

2/ All work was completed under USAID PIO/T numbers 730-170-2-(21)-20031 and 730-170-2-(31)-30027.

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ACKNOWLEDGEMENTS

This study was completed under a Participating Agency Service Agreement between the Economic Research Service, United States Department of Agriculture, and the United States Agency for International Development, Vietnam Mission. The authors are indebted to M. V. Sorenson, S. A. Robert, Jr., E. G. Walters, H. W. Magnusson and R. H. Pollock of the Mission for helpful guidance and counsel throughout the study.

Director Tran Van Tri and Deputy Director Le Van Dang of the Directorate of Fisheries, Vietnam Ministry of Agriculture, and their staff gave valuable assistance to the ERS team on a number of occasions which was greatly appreciated. Thanks also go to the officers of the Vietnam Export Development Center, the Vietnam Agricultural Development Bank, the Hai Bang Fishermen's Cooperative, and the more than 200 owners, fishermen, and middlemen who provided information and invaluable help during the study.

The help of a number of colleagues was greatly appreciated by the authors. A special word of thanks to W. A. Faught, W. S. Hoofnagle, K. D. Brouillard, E. H. Farstad, J. O. Kling, James Sayre, D. P. Winkelmann, and S. B. Hutchison. The typing of many drafts and the final manuscript were done most efficiently by Christine M. Bryant. Data analysis assistance was ably provided by Lula W. White. All of these people merit our sincere thanks.

SUMMARY

Restrictions to expanding fishery exports from Vietnam to earn foreign exchange and create more employment and income at home relate more to the industry's supply capability, its profitability, and the domestic needs and marketing system than to whether export markets exist in other countries. These matters became the subject of intensive study by the authors of the following report in late 1973 and early 1974.

EXPORT OPPORTUNITIES EXIST

The demand for Vietnamese fish products was proven when joint Vietnamese-American teams visited Singapore and Japan in 1972 and 1973 to appraise the import potential for 38 Vietnamese fish species and products. Importers in Singapore and Japan showed particular interest in 16 of the species and products. Imports of these 16 products by the two countries exceed 188,000 metric tons (M.T.) yearly, and are worth more than U.S. $388 million. Both countries are interested in seven species and products: shrimp, lobster, cuttlefish, squid, snapper, processed eel and eel fry, and mackerel. Nine other products are of interest to one or the other market, but not both: Japanese importers want tuna, jellyfish, hard clams, crabs, and aquarium fish while Singapore traders prefer threadfin, shark fins and meat, abalone, and sea cucumber.

Demand for these imports is sufficiently strong in Japan and Singapore, not to mention other areas such as Hong Kong, Europe, and the United States, that exports from Vietnam can be expanded greatly by 1980 if the following criteria are met: 1) cost plus insurance plus freight (c.i.f.) prices in the importing country for a given product must be equal to or greater than the total Vietnamese cost of procurement, processing, and transfer to that country; 2) products from Vietnam must meet the quality specifications in the importing country on a sustaining basis and at competitive prices; 3) Vietnam's domestic fish utilization needs must be met concurrently with export activities, and 4) the fish resource base in Vietnam's waters must not be adversely affected by harvest pressures to meet supply contracts.

VIETNAM'S SUPPLY CAPABILITY

The analyses in the report which follows show that additional stocks of between 100,000 and 350,000 M.T. of demersal fish would be available for exploitation off the Mekong Delta and in the Gulf of Thailand (table 1). This is based primarily on published research from Vietnam and Thailand government sources and catch records made available by fishermen. The potential catch of pelagic fish in these same waters may run as high as 496,000 M.T. 1/ At current prices

1/ Demersal fish are those that live on or near the ocean bottom. Pelagic fish, however, may be middle or surface feeders and may live and move in large schools. Different fishing gear and technology are required for each.

Table 1--Estimated yearly potential yield and catch, demersal and pelagic fish, Mekong Delta region and Gulf of Thailand, Vietnam

	Demersal fish		Pelagic fish		
	Trawlable ground	Total ground	Mekong Delta	Gulf of Thailand	Total
	Metric tons				
Potential yield............	950,000	1,200,000	566,000	380,000	946,000
Yearly catch (all nations)..	850,000	850,000	188,000	262,000	450,000
Potential catch............	100,000	350,000	378,000	118,000	496,000

Source: Original data.

received by fishermen in Vietnam, these potential catches of demersal and pelagic fish would have an additional value of approximately U.S. $415 million. However, the fish are spread over a vast area probably exceeding 531,000 square kilometers (km^2).

Production per boat, either on a yearly or per trip basis, is low in Vietnam. Consequently, costs per kilogram (kg) of fish landed are high by comparison with other developing countries. Recent increases in fuel and ice costs in Vietnam only aggrevate the already difficult situation.

The following production data were developed from information furnished by Vietnamese fishermen or from records made available to the authors. The data are representative of the productivity of Vietnam's current commercial fleet, which is composed of approximately 4,800 of the country's largest boats. They do not represent productivity for the thousands of itinerate fishing boats of all sizes which are plying the coastal or inland waters. The production data in table 2 show that only a few of the large and medium trawlers and gillnetters 2/ currently fishing in Vietnam meet or exceed one generally accepted standard for a "good" fishing operation, i.e., 2.5 M.T. of fish caught per year per gross metric ton (G.M.T.) of boat. 3/

2/ Gillnetters are fishermen who use a net set upright in the water to catch fish whose gills get entangled in its meshes.

3/ Most trawling done by Vietnamese fishing boats is done in pairs, i.e., two boats set, pull, and haul one trawl net.

Consequently, operating costs per kg of fish landed are high (table 2). The medium-size trawlers had the lowest average cost, with U.S. $.13 per kg. These costs were based on data obtained in the fall of 1973 when fuel cost approximately 52 piasters (VN $) per liter (the exchange rate was VN $535 per U.S. $1). They represent operating or trip costs only, and include no depreciation, interest, or owner equity charges. It is not unusual today in developing country fisheries for <u>total costs</u> per kg to average from U.S. $.15-U.S. $.24.

Table 2--Estimated Vietnam commercial fishing fleet production levels and operating (trip) costs, fall-spring, 1973-1974

Vessel type	Production		Operating cost		
	Per trip	Per year	Fuel @52 VN$/liter	Fuel @95 VN$/liter	Fuel @125 VN$/liter
	- - Metric tons - -		- - - U.S. $ per kg - - -		
Large pair trawlers ... (90-130 G.M.T.)	20-40	300-500	.22	.27	.32
Medium pair trawlers... (20-40 G.M.T.)	1-15	110-120	.13	.16	.19
Small trawler	---	---	.18	NA	NA
Gillnetters............	2-10	30-60	.17	NA	NA

Source: Original data.

When the components of Vietnamese fishing fleet operating costs are analyzed, it becomes evident that fuel and ice costs are too high (table 3). Fuel and ice costs, as a general rule, should not exceed 20-30 percent of total operating or trip costs in developing countries. Ways must be found to increase each boat's total catch and to reduce the high prices charged for fuel and ice.

Table 3--Percentage distribution of estimated operating costs for larger Vietnamese trawlers, fall 1973 and spring 1974

Item	Fall 1973	Spring 1974
	- - - - - - - - - - Percent - - - - - - - - - -	
Fuel.....................	40	57
Crew.....................	35	24
Ice......................	8 1/	10 1/
Food.....................	5	3
Other....................	12	6
Total.............	100	100

Source: Original data.

1/ Ice costs may be significantly higher for the smaller vessels.

Two other problem areas requiring solution if Vietnam's fishery industry is to continue to grow and be profitable relate to the domestic marketing system: 1) the current system is extremely complex and costly and 2) raw fish collection systems around and in the country ports will not be able to handle additional catch with present facilities and methods of operation. The latter point is particularly true for shrimp and trash fish for fish meal manufacture.

The fish marketing margins and costs shown in table 4 do not seem out of line by general standards, given the complexity of the present system and the risks and financing advanced by middlemen. However, it is evident that there is much inefficiency built into the present system. Shrinkage and quality losses are high, delays are significant, fish are handled and rehandled too many times in extremely small lots, and the system will not be able to handle additional thousands of M.T. of product as now operated.

Table 4--Fish marketing prices and margin shares in Saigon, fall 1973

Price level	Price per kg		Percent of retail price
	U.S. $	VN $ 1/	
Saigon retail	.47	252	100
Saigon wholesale	.28	150	60
Country port, fisherman	.17-.20	91-107	36-43

Source: Original data.

1/ The official exchange rate was VN $535 per U.S. $1 in fall of 1973.

The cost distribution, fisherman-wholesaler margin at Saigon and other ports, breaks down as follows:

	U.S. $ per kg
Official taxes	.010 - .013
Porters in ports	.020 - .055
Transportation	.030 - .066
Port collector - middlemen 4/	.020 - .030
Saigon commissions 4/	.020 - .020
Average range	.100 - .184 5/

4/ Includes operating costs such as labor, boxes, ice, credit cost, etc., as well as profits.

5/ When boats unload in Saigon rather than other ports, the typical margin is probably in the range of U.S. $.08 to $.11 since truck transportation and some other costs are not incurred.

The best evidence of the inadequacy of the present fish collection system is the difficulty shrimp and fish meal processing plants are having obtaining supplies to operate profitably. With present output capacity, it is estimated that the 1973 frozen shrimp export of 3,840 M.T. could all have been processed in 41 working days. Fish meal plants are operating at 20 to 30 percent of capacity, or, in several cases, have ceased operations completely since the fall of 1973.

Domestic utilization of fish has been increasing rapidly in Vietnam since 1960 as population and incomes have increased, from an estimated 262,000 M.T. of fish in 1960 to 687,000 in 1973. Three projections were made to 1980 utilizing selected explanatory variables at conservative, average, and optimistic levels. The projections show potential domestic utilization demands of 778,900; 850,000; and 938,000 M.T., respectively. The reported Vietnam catch in 1973 was 713,566 M.T., of which 91,312 M.T. was fresh-water fish.

It is evident that the total Vietnam catch must continue to increase rapidly if domestic needs are to be met and foreign exports expanded. The potential catch data for waters fished in the Mekong Delta and Gulf of Thailand, presented above, suggest that an additional 596,000 to 846,000 M.T. of demersal and pelagic fish are available to be harvested. These fish are spread over a wide area in international waters and are available to other nations as well as Vietnam. Adding 200 medium boats to the present fleet of 2,200 boats over 20 G.M.T. could expand total production 150,000 M.T. by 1980 with basic improvements in technology and about $30 million additional capital.

An increase of 250,000 M.T. in total production appears near the maximum technically achievable. It could press the available fish stock to sustain this rate. To produce 950,000 M.T. by 1980 (an increase of 350,000 M.T. above the 1973 marine catch) would require a more rapid growth in vessel numbers, perhaps 1,500 more. Achieving such production is probably beyond technical and economic feasibility at this time.

The following conclusions and recommendations show the changes necessary for Vietnam's fishing industry to experience the profitable expansion needed by 1980.

Conclusions

1. Fish production costs are high in Vietnam.
2. Fish marketing costs are high in Vietnam.
3. Additional demersal and pelagic stocks are available and exploitable.
4. Fishing fleet expansion has left gear, fishing, and vessel technology underdeveloped.
5. Shrimp and fish meal processing capacity greatly exceeds raw material supplies.
6. Export expansion depends on improved collection systems as much as increased production.
7. Port facilities are inadequate.

Recommendations

1. Develop gear, fishing, and vessel technology.
2. Expand market technological and organizational development.
3. Improve the ports at Rach Gia and Vung Tau immediately.
4. Stop subsidies and support to vessels over 75 gross M.T. in the intermediate run.
5. Make vessels of 50-75 gross M.T. feasible through cost reductions (more time fishing at sea, more efficient labor productivity, shorter turn-around time, better maintenance, etc.), expanding single trawl capability, and better management.
6. Initiate shrimp exploration in coastal waters immediately.
7. Use chartered vessels with air reconnaissance to locate and chart pelagic stocks and their movements.
8. Make basic policy changes at the highest government levels to help fishermen improve their productivity and profit levels. The most urgent need is to permit and encourage the use of navigation charts, marine compasses two way radios, and electronic fish locating gear. Some method must be found to reduce high fuel costs. Sanitary ice should be made available in larger quantities and at lower cost.

More detailed recommendations are presented in the text which follows.

DEMAND AND SUPPLY POTENTIALS FOR SOUTH VIETNAM'S FISHERY INDUSTRY

INTRODUCTION

Early in 1972, the United States Agency for International Development (USAID) negotiated a Participating Agency Service Agreement with the United States Department of Agriculture (USDA) to assist the Vietnamese Ministry of Agriculture in a study of the export demand potentials for fish and fish products in relation to domestic demand needs and supply conditions. The study was to locate potential export markets for Vietnamese fish products to help Vietnam earn needed foreign exchange. It was to also find ways to increase employment and income opportunities for Vietnamese citizens, and to manage the country's fish resources for maximum long-run benefits.

This research is part of a series of export opportunity analyses conducted by USDA in cooperation with the USAID Mission/Vietnam and the Vietnamese Ministry of Agriculture; other analyses studied South Vietnam's timber, agricultural crops, and livestock industries. The report which follows briefly summarizes the fisheries export demand phases of the overall study, and then analyzes, in depth, Vietnam's domestic fish demand situation, and its fishery industry supply capability, cost structure, and profitability. A final section of the report includes recommendations for improvement in Vietnam's marketing system for fish products, and several observations about fisheries policies and institutions in the country.

PROCEDURES

To determine if export opportunities existed (the objective of the two studies completed earlier), standard international trade statistics were obtained for Singapore and Japan for the most recent 5-year periods. Data were summarized for each country by species or groups relative to quantities imported and exported, total values of each, average unit prices, sources of the imports, and destinations of exports. Trends and projections were also developed from analyses of the secondary data to help guide research workers in their field work which followed.

Combined Vietnamese-American teams then visited Singapore in July 1972 and Japan in February 1973 to obtain primary data related to 33 fish species and 5 fish products which were believed to be available in South Vietnam in commercially marketable quantities. Additional information was obtained about methods of trading, costs of trade, major firms handling imports of specific fishery products, health and other quality considerations, packing and shipping specifications, foreign exchange considerations, import quotas and tariffs, and other factors which influence trade.

In October-November 1973, another Vietnamese-American team spend 10 man-weeks in Vietnam gathering primary data about supply conditions and the domestic demand and marketing situation. These data are detailed in the report which

follows. The team interviewed more than 200 fishermen, middlemen, processors, exporters, government officials, and other interested persons. Physical facilities and organizations were visited in Saigon, Cholon, Vung Tau, Phuoc Tien, Rach Gia, Nha Trang, and Phan Thiet, the principal fishing ports for marine fish (secondary data show that approximately 75 percent of Vietnam's annual marine fish catch moves through these ports).

The in-depth interviews completed at these locations, plus the follow-up interviews held at a number of the organizations, provided the primary data used to evaluate present performance of Vietnam's commercial fishery industry. The authors were often given access to bookkeeping records kept by fishermen, middlemen, cooperatives, and government officers. These data form the basis of evaluations of fishery fleet productivity, by size and type of boat, costs of operation, profitability, and methods and costs of marketing.

These interviews and data also provided insights into the Vietnamese fish processing industry, including evaluations of the raw fish supply situation, inventories, collection systems, input costs, processing costs, market prices, profitability of the firms, processing equipment, and output capacity. These formed the basis for evaluations about the industry's present output efficiency and expansion capability.

Observations were also made during the field trips about port and wharf facilities; their organization and operation; the gathering, storage, transportation, and marketing systems in use; and barriers to expansion and improvements.

Data were also obtained from the Fisheries Branch, USAID Mission/Vietnam; the Directorate of Fisheries, Vietnam Ministry of Agriculture; and other ministries. These were useful in evaluating the reliability and adequacy of data obtained from other sources. Research reports were also obtained from FAO/UN and other multinational organizations which were useful in evaluating fish populations, potential stocks, and harvests in the South China Sea and the Gulf of Thailand in the vacinity of South Vietnam.

EXPORT DEMAND HIGHLIGHTS FOR VIETNAM FISH PRODUCTS IN SINGAPORE AND JAPAN

Only 7 of the 38 Vietnamese fish species and products submitted to the study teams for export demand analysis were of interest to the majority of traders interviewed in both Singapore and Japan. These were shrimp and prawn, lobsters and crayfish, snapper, mackerel, squid, cuttlefish, and eel. World demand and prices are so strong in relation to current world supplies of shrimp and prawn, lobsters, and crayfish that these species logically generate the most interest in contacts between Vietnamese and importers. An indication of the size of the import markets for these fish species in Singapore and Japan is shown in table 5. 6/ The relatively strong demand for squid, cuttlefish, eel, mackerel,

6/ Detailed 1971 and 1972 data for Singapore and Japan are shown to indicate the aggregate size of total imports of the species of interest in Vietnam. Similar detailed data were not obtained for 1973 because of time and financial limitations; however, aggregate import statistics for the two countries show that demand continued to expand for fish products in 1973.

Table 5-- Selected Fish Imports, Values and Average Prices, Japan and Singapore, 1972 and 1971

Fish species	1972 Japan			1971 Singapore		
	Weight	Value	Average price	Weight	Value	Average price
	Metric tons	Million dollars	US $ per M.T.	Metric tons	Million dollars	US $ per M.T.
Shrimp, prawn, and lobster...	88,120	296.8	3,368	9,908	14.0 1/	1,414 1/
Cuttlefish and squid.........	27,844	21.3	764	3,883	1.5 2/	388 2/
Snapper....................	3,787 3/	3.2 3/	835 3/	3,736	1.2	313
Eel and eel fry..............	214	9.2	43,051	1	---	5,001
Mackerel....................	10,326	7.3	705	5,235	2.9	554
Total or average............	130,291	337.8	2,593	22,763	19.6	861

Source: Demand for Selected Vietnam Fish Products in Singapore, ERS FDD Field Report 31, USDA cooperating with USAID, May 1973, and Export Opportunities for Selected Vietnam Fish Products in Japan, ERS FDD Field Report 43, USDA cooperating with USAID, January 1974.

1/ Priced at average processed product import values.
2/ More than 90 percent of total deliveries were fresh or unprocessed.
3/ Includes small quantities of sea bream.

and snapper in Singapore and Japan is more closely related to Asian taste preferences than world demand.

An additional nine species and products were of special interest in one or the other market, but not in both. Thus, the Vietnam industry should carefully study export possibilities to Japan for tuna, jellyfish, hard clams, crabs, and aquarium fish. Similar detailed studies should be made for possible exports to Singapore of threadfin, shark fins and meat, abalone, and sea cucumber. The quantities imported, total value, and average prices of these species in each country are shown in table 6.

Table 6--Specialized fish product imports, values, and average prices, Japan and Singapore, 1972 and 1971

Country and fish species	Weight	Value	Average price
	Metric tons	Thousand U.S. $	U.S. $ per M.T.
Japan: 1972			
Tuna, bluefin, and yellowfin	9,431	9,800	1,039
Jellyfish	5,331	7,100	1,336
Hard clams	15,372	6,900	448
Crabs	2,519	3,400	1,344
Aquarium fish	50	2,400	48,640
Singapore: 1971			
Threadfin	629	777	1,235
Shark fins and meat	1,199	190	159 1/
Abalone	12	32	2,723
Sea cucumber	16	7	438
Total or average	34,559	30,606	886

Source: Demand for Selected Vietnam Fish Products in Singapore, ERS FDD Field Report 31, USDA cooperating with USAID, May 1973, and Export Opportunities for Selected Vietnam Fish Products in Japan, ERS FDD Field Report 43, USDA cooperating with USAID, January 1974.

1/ Processed shark fin imports amounted to 17 M.T. in 1971 at an average price of $1,626 per M.T.

In effect, the list of 38 Vietnamese fish species and products was reduced to 16 by demand considerations in the Singapore and Japanese markets. This does not mean that other species are of no interest to individual importers, but volumes are modest and trade terms will require individual negotiation among private firms.

The viability of expanding exports of the 16 species of interest in Japan and Singapore is based on a number of economic and other factors. These will be discussed in detail in the remaining sections. Principal among them are: 1) that c.i.f. prices in the importing country for a given product are equal to or greater than total costs of procurement, processing, and transfer to that country, and are equal to or lower than competitors' selling prices; 2) that products from Vietnam meet or exceed the quality specifications in the importing country on a sustaining basis; 3) that the resource base in Vietnam fishing waters will not be adversely affected by harvest pressures occasioned by the need to meet supply contracts which must be assured as to quantities delivered at times desired; and 4) that domestic fish utilization needs are met concurrently with export activities.

DOMESTIC UTILIZATION

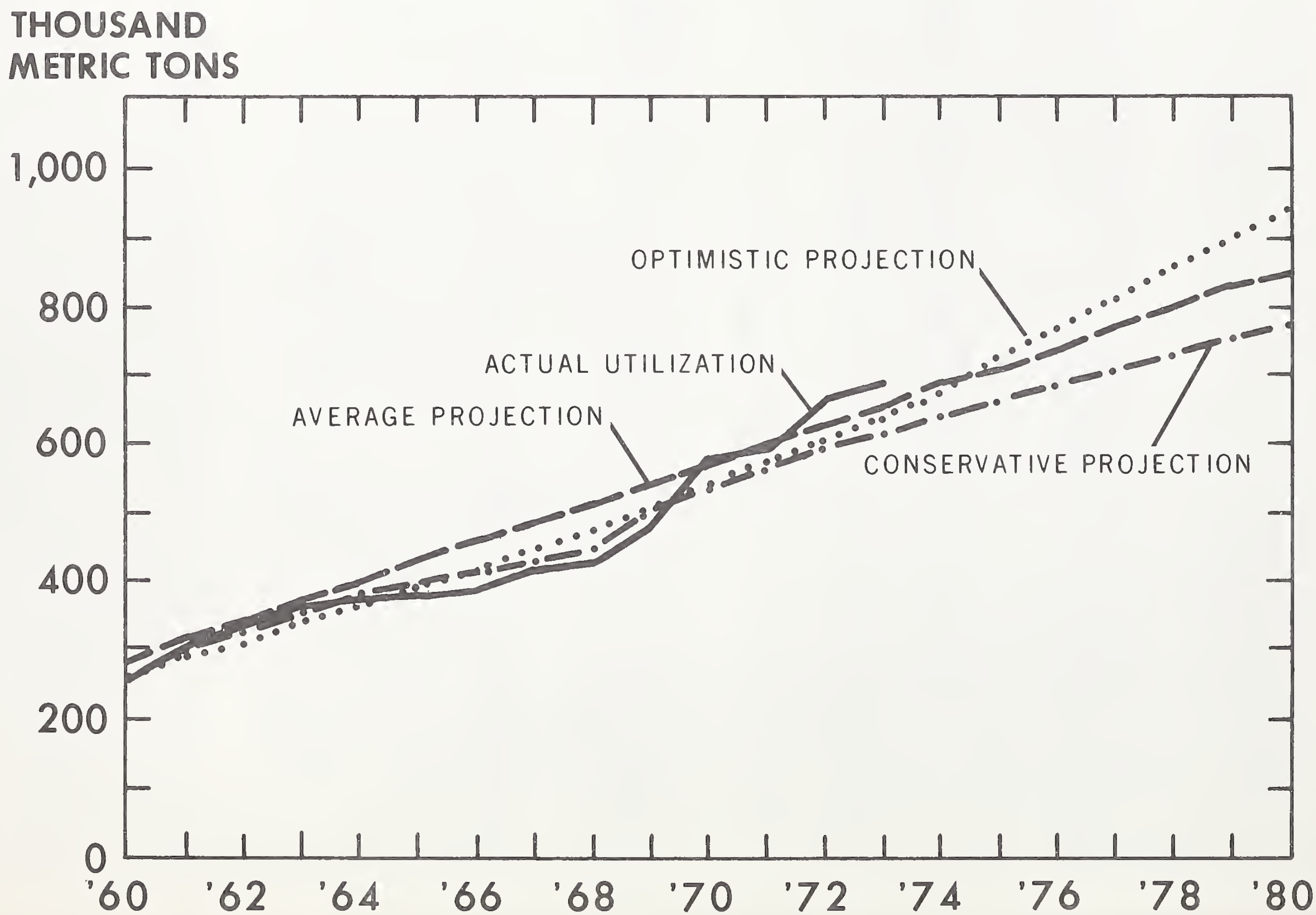
Any export potential study must consider both the supply potential and domestic utilization needs. Projections of supply and domestic utilization to a chosen future time make it possible to evaluate if surpluses beyond domestic needs will be available for export to other countries.

Data were obtained about South Vietnam's total utilization of fish products, on a live weight basis, from 1960 through 1973. Total utilization was defined as total fish landings plus fresh water fish marketings plus imports less exports for each year. Total domestic utilization of fish was then projected to 1980 at three different levels based on specific assumptions and projections for selected explanatory variables. The explanatory variables chosen to project domestic fish utilization needs in Vietnam by 1980 were: 1) annual gross or per capita national product; 2) aggregate annual population; 3) average wholesale price of fish in Saigon; 4) average wholesale price of pork in Saigon; 5) a level of hostilities variable; 6) time; 7) total net exports of fish; and 8) total domestic fish landings. 7/

The actual total domestic fish utilization data for Vietnam from 1960 through 1973 are shown in figure 1. The three projections to 1980, labeled OPTIMISTIC, AVERAGE, and CONSERVATIVE, are also shown in the figure.

7/ Details regarding specification of the variables, the models chosen, and the resulting functions are presented in Appendix A.

FIGURE 1. -- VIETNAM: TOTAL UTILIZATION OF FISH, LIVE WEIGHT BASIS, 1960-1973 AND THREE PROJECTIONS TO 1980



CONSERVATIVE PROJECTION

The conservative projection shows a domestic utilization need of 778,900 metric tons (M.T.) of fish, on a live weight basis, by 1980. This compares with actual domestic utilization in 1973 of 687,000 M.T. Thus, the Vietnam fishing industry will have to continue to expand its catch and marketings by another 92,000 M.T. in the next 7 years just to meet domestic consumption needs, assuming no increase in the present level of fish exports.

Total domestic fish utilization has already increased from 262,000 M.T. in 1960 to its 1973 level of 687,000 M.T. This represents an increase of 425,000 M.T. in 13 years, an increase nearly double the total utilization in 1960. It is difficult to envision the same rate of growth in the next 7 years. The conservative projection to 1980 takes this factor into consideration. While per capita utilization increases from 33.4 kilograms (kg) per capita in 1973 to 37 kg in 1980, it increases at a decreasing rate.

The slowing in the growth of total and per capita utilization of fish in this projection is attributed to several factors: 1) per capita and aggregate gross national product, which are crude measures of family income and purchasing power, will not continue to grow as rapidly in the next 7 years in Vietnam as they did in the previous 13 years; 2) there is some substitution between pork and fish in Vietnamese diets as incomes rise; 3) the level of hostilities is somewhat uncertain, but this has a dampening effect on both availability and utilization of fish; and 4) continued population growth is the most significant explanatory variable in the continued expansion of total fish utilization needs to 1980.

AVERAGE PROJECTION

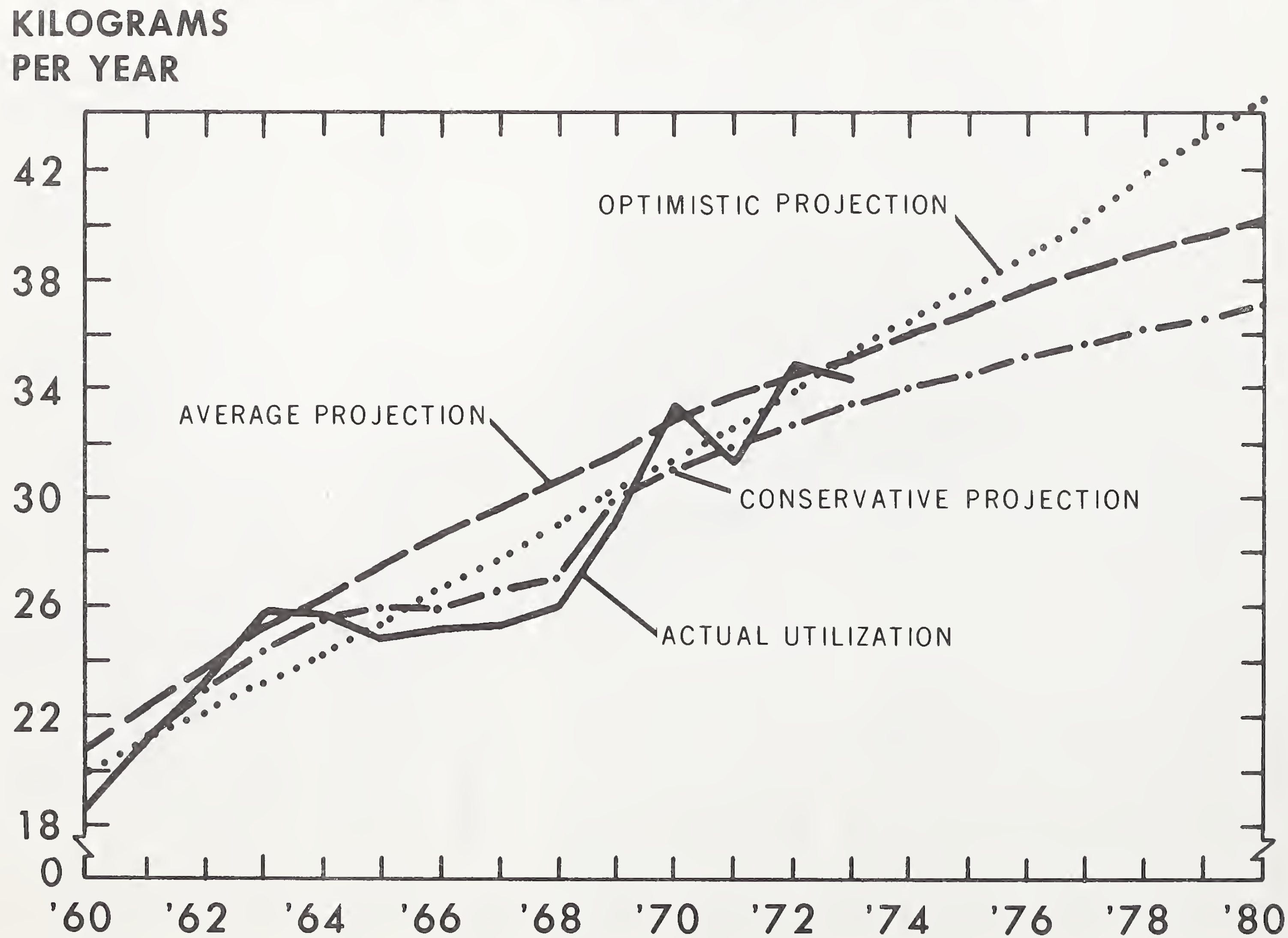
The average projection shows a total domestic utilization need of 850,000 M.T. by 1980. Population and income explain the continued expansion in total and per capita utilization at nearly the same rate to 1980 as the average expansion rate in Vietnam since 1960.

Per capita utilization increases significantly from 20.8 kg in 1960 to 40.2 in 1980. Two points are relevant, however. First, the 40 kg per capita utilization is very similar to that for Taiwan, Thailand, and South Korea, where dietary habits are similar to those of Vietnamese. By way of contrast, per capita consumption of fish in Japan is currently 64 kg per year, and is projected to increase to 73 by 1980. Secondly, the increase in per capita utilization in this projection is at a slightly decreasing rate (figure 2). This is a normal phenomenon for food as higher levels of consumption are achieved over time.

OPTIMISTIC PROJECTION

The optimistic projection suggests a total domestic utilization of 938,162 M.T. of fish by 1980. The increased utilization in this projection is explained by

FIGURE 2. --VIETNAM: PER CAPITA UTILIZATION OF FISH, LIVE WEIGHT BASIS, 1960-1973 AND THREE PROJECTIONS TO 1980



several optimistic assumptions: 1) that Vietnam's population growth will continue at the average yearly rate of the past 11 years, 2.7 percent, causing most of the increase in aggregate fish utilization; 2) that increases in gross and per capita national product will continue at the same rate as in recent years, exerting an important upward force on total fish utilization; and 3) that the normal inverse relationship between price of fish and quantity demanded does not exert a significant dampening effect on fish utilization.

The latter point has actually happened in South Vietnam in the past 10 years. Real fish prices at retail have continued to increase, but per capita utilization has also continued to increase, and at a more rapid rate. Apparently, rapidly increasing per capita incomes in Vietnam, coupled with a high income elasticity of demand, more than offset the usual negative price effects for fish. A second possibility is that, despite the high level of hostilities during the period, fresh fish were available in the market places more readily than other protein foods at prices consumers were willing to pay. Another possibility is that real fish prices did not advance as rapidly as real prices of other foods.

A final observation from figure 2 is that per capita fish consumption will continue to increase until 1980 at a slightly increasing rate. This would be similar to the experience in Japan over the past 15 years, and implies that fish and fish products are superior foods in Vietnamese diets. It also implies that little substitution takes place between fish and other foods.

FISHING OPERATIONS

LARGE TRAWLERS

Characteristics of Vessels and Operations

There are 21 large steel trawlers in Vietnam, ranging in size from 90 to 314 G.M.T. All but two are between 90 and 130 G.M.T. About 18 of these were actively fishing in late 1973. Most of the vessels operate as pair trawlers, although the larger vessels trawl singly. Pair trawlers, as the name implies, work in pairs to tow one net. This method of fishing permits two relatively underpowered trawlers to tow a large net at reasonable speed (typically 2.5 to 3.5 knots).

The 90-G.M.T. vessels have 300 horsepower engines or higher, the largest having about 500 horsepower. The vessels in the 90-130 class are reasonably powered for the pair trawling which most pursue. They might be considered underpowered for single trawling in the currents that exist off the Vietnamese eastern coast.

FIGURE 3: PAIR TRAWLING

Source: *Fishing Boats of the World:2*, Jan Olof Traung, Fishing News (Books) Ltd., London, 1960, p.110.

The vessels are principally of Japanese construction, although four are U.S. built and two were built in Saigon. At least one is a converted naval patrol boat. Most of the steel vessels are well equipped with electronic gear for fish finding and communications.

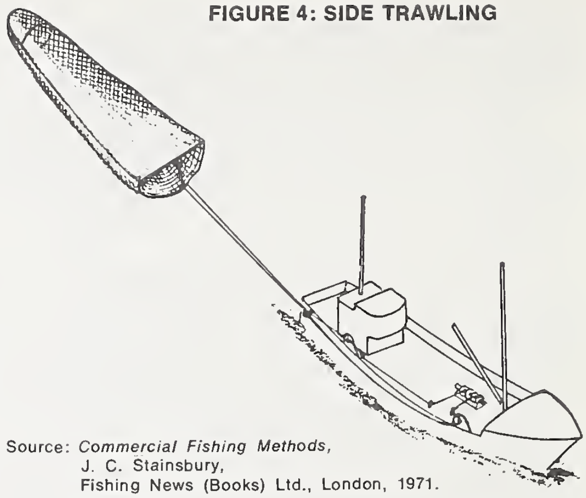
Several vessels have refrigerated holds, two are equipped with contact freezers for shrimp, and at least three shrimp trawlers have brine chill tanks. Ice is typically carried even on those vessels with refrigerated holds.

At least three shrimp trawlers are doubled rigged. Most of the others are side trawlers; at least one is a stern trawler. A double-rigged trawler has two booms that can be extended from the sides of the vessel. It is possible to tow a net from each of these booms. A side trawler sets the trawl net over the side of the vessel and tows a single net. Typically, the deck house on such a vessel is aft. A stern trawler sets a single trawl net over the stern of the boat and typically has its deck house forward.

The pair trawlers tow nets made of very heavy twine, often a single mesh size throughout (2 inches stretched). Little can be said about the height of opening of the nets except that, given their design, the typical net probably does not open more than 3 meters (m). Towing times range from 1-3/4 to 3 hours depending upon catch, rates, and other conditions.

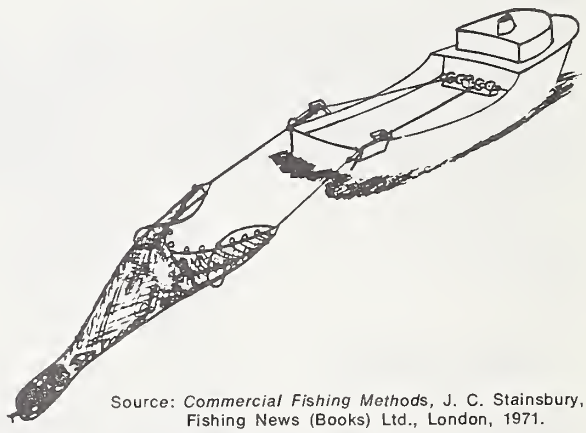
Trip length varies from 12 to 30 days. Thirty days is unusual and most trips average about 14 to 15 days; a few go 21 days. From 4 to 7 days are required in port between trips. The rather long turnaround times on short trips are often dictated by market conditions. If a full load of, say, 30 M.T. were sold in 1 day, the prices in the Saigon market, which handles about 110-120 M.T.

FIGURE 4: SIDE TRAWLING



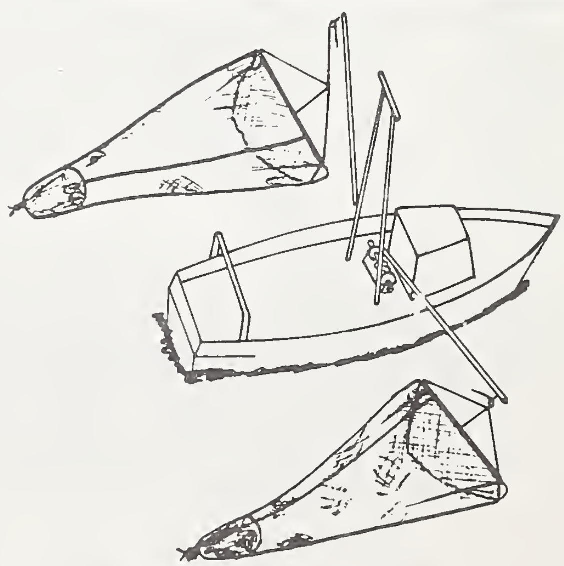
Source: *Commercial Fishing Methods*, J. C. Stainsbury, Fishing News (Books) Ltd., London, 1971.

FIGURE 5: STERN TRAWLING



Source: *Commercial Fishing Methods*, J. C. Stainsbury, Fishing News (Books) Ltd., London, 1971.

FIGURE 6: DOUBLE TRAWLING FOR SHRIMP



Source: *Commercial Fishing Methods*, J. C. Stainsbury, Fishing News (Books) Ltd., London, 1971.

a day, would decline substantially. Hence, fish is often sold over 3 or 4 days. Vessels with a 14-day trip can manage about 210-240 days at sea each year, with 150 to 190 days of fishing. Few boats achieve the upper limits and many apparently do not achieve the lower feasible limits. Weather, breakdowns, gear losses, and a variety of other factors contribute to lost time.

The typical fishing day is 14 to 16 hours, although some vessels fish virtually around the clock. Shrimp trawlers generally operate during evening and night and fish trawlers operate during the day.

Productivity - Catches

The so-called catches of the large trawlers really reflect catches of marketable fish. The actual catch can be quite different. For example: one captain reported a specific catch in a single tow of 600 kg of which 125 kg were marketable and 475 kg were discarded as trash. A number of comments by owners indicated that catches of so-called trash fish were considerably greater than catches of marketable fish. However, a Japanese exploratory fishing vessel reported an average of only 7.29 percent "trash" in catches in the South China Sea and Gulf of Thailand. It did, however, report 34.13 percent "miscellaneous fish" (fish not identified) for the whole area and 58.65 percent for the Gulf of Thailand. It is possible that the definitions of trash and miscellaneous are not mutually exclusive. In any event, there is evidence that much of the fish caught is not being brought to shore. (Normally, discarded fish from trawls are either dead or die.)

The 90-130 gross M.T. (G.M.T.) pair trawlers with trips of 12-15 days report average catches of fish of 20 to 40 M.T. per trip. About 30 M.T. per trip was the most commonly reported figure. Annual production ranges from 300 to about 500 M.T. of fish per pair of trawlers. The annual gross stocks would range from about $56,000 a pair to $117,000. 8/ Catches per day of fishing average from 2 to 3 M.T. and from 150 to 210 kg per hour.

By way of contrast, records on two New Zealand single trawlers (of about 60 G.M.T.) indicated production of 450 M.T. per year. Canadian small single trawlers (overall length of 17 m) averaged 393 M.T. a year from 1964-67 in Nova Scotia. In a more nearly similar situation, small (overall length 15 m) trawlers in the Persian Gulf are expected to produce 300 M.T. per year. These vessels are smaller than the 90-130 G.M.T. trawlers in Vietnam, yet produced, or are expected to produce, as much or more fish.

The catch per G.M.T. of vessel in the steel trawler fleet is about 2 M.T. per year. This is generally lower than necessary for profitable operation, even at present high fish prices. The Taiwanese fleet, for example, produced about 3.7 M.T. per year per G.M.T. of boat in the 100 to 200 G.M.T. class, and 2.5 M.T. in the 50-foot class in 1965. Other trawlers in 1970 averaged 3.2 M.T. per boat G.M.T., but had been down to 1.9 M.T. per G.M.T. in 1967.

8/ U.S. dollars are indicated as $ through the rest of this report, and piasters are indicated as VN $.

In sum, the catches of the Vietnam large trawlers are relatively low. This may be due to deficiencies in gear, lack of experience and skill in fishing, time lost from fishing due to breakdowns, extended port stays for marketing fish, and a variety of other factors.

Shrimp trawlers normally catch both fish and shrimp (about 2-5 M.T. of fish for each M.T. of shrimp, not considering discarded fish). Shrimp catches range from 10-20 M.T. of export shrimp (heads on) per year per boat. Export shrimp constitute as much as half the catch. For comparison, the fleet out of Ciudad del Carmen in Mexico averaged 22.3 M.T. per boat of marketable (heads off) 9/ shrimp in 1972. Larger boats (over 300 horsepower and 21 m overall length) average 24.3 M.T. per year. Boats out of Mazatlan, Mexico, averaged 17.2 M.T. (heads off) in 1969, down from over 42 M.T. in 1962. Kuwaiti boats produce about 42 M.T. of shrimp (heads off) per year. Catches per day of fishing in Vietnam range from 35 kg to over 100 kg. However, catches fluctuate greatly from day to day. Average catches per day are probably between 35 and 45 kg of export shrimp.

Manpower - Crews

The crews of pair trawlers in the 90 to 130 G.M.T. range vary from 15 to 17 men per boat. There will typically be one master fisherman for the pair. Each vessel will have a master or captain, radioman, and usually an engineer. Fishermen's wages range from $38 to $75 a month plus food, which varies from $10 to over $20 per man per month. In addition, there are a variety of incentive schemes employed. Where incentives are used, they usually consist of a bonus for production above what is considered an average trip. One firm shares 50/50 after all expenses have been deducted from the gross (i.e., the crew receives 50 percent of the net stock and the boat retains 50 percent).

It has long been recognized that the captains or master fishermen are crucial to the success of fishing enterprises. Great variations in earnings of fishing vessels can be related to the quality of the chief officer. His performance in keeping the boat fishing and fishing in the right places is obviously important. While Vietnam has qualified vessel captains for boats of this class, few are good fishermen. Hence, Japanese master fishermen have been and are being used. In some instances, there has been conflict between foreign masters and Vietnamese crews. The number of qualified Vietnamese captain-fishermen is increasing, albeit slowly.

There are considerable differences in salaries paid foreign and indigenous captains, and foreign captains may also receive part of their salaries in foreign currency (yen or dollars). Vietnamese captains receive equivalent to U.S. $230 to $280 a month while Japanese captains or master fishermen may earn about $560.

9/ To convert "heads-off" weight to live weight, multiply by 1.59. This conversion factor is from Fishery Statistics of the United States, 1964, p. 514, and reflects a yield of 63 percent, which is close to that obtained in Vietnam.

Engineers' pay varies widely, from $95 a month to over $200. The higher figure is unusual, although a well-qualified engineer-mechanic is an extremely valuable crew member and is often paid at a scale approaching that of a captain.

Radio operators are required on vessels of this size. Most owners object to the requirement, which costs about $95 a month (not including food). Given effective voice radio communication, it is indeed difficult to appreciate the need. One argument for a qualified radioman is that code transmission would be necessary in the event of voice communication failure.

The problem of obtaining qualified crewmen, from captain down, is an important one. Development of the fleet of large trawlers in Vietnam has not gone smoothly, and crew problems still exist. The root of the difficulty would not appear to be salaries; Vietnamese crews receive a share of the gross stock comparable to that in many countries, and salaries are not low relative to those in other less developed countries. However, the crews are large and accommodations are not always adequate. A major difficulty is the reluctance of fishermen to spend extended periods at sea, even at relatively good pay. This is, of course, not a problem peculiar to Vietnam.

Any expansion of the large trawler fleet would have to be premised on either foreign fishing masters or the development of a training program or both. The requirement that captains of fishing vessels have papers qualifying them for the coastal steamer trade when they do not need to have qualifications or experience in fishing certainly is problematic as well.

Generally, the comments above also apply to shrimp boat crews. Crews on shrimp boats are smaller than those on fish trawlers, however; they average about seven men, including master, engineer, and radio operator.

Operating Costs

It is difficult to accurately assess production costs for fishing vessels in this class since the boats vary in power, equipment, size, and other factors. However, some estimates can be made and some peculiarities of the cost structure of Vietnamese vessels can be indicated.

Earlier estimates of operating costs have typically been too low. The recent rises in fuel costs have been a major factor. For example, a Kyokuyo Co. survey used a price of VN $16 per liter and the Aisa Development Bank used VN $10 per liter. 10/ Under these prices, fuel accounted for 15 percent and 20 percent of total operating cost, respectively. However, under fuel prices at, say, VN $50 per liter, 11/ fuel accounts for 40 percent and 57 percent operating costs. In both cases the use of present fuel costs would have eliminated any profit at the assumed revenues.

10/ A Trawling Survey of the South China Sea and the Gulf of Thailand, Kyokuyo Co., Japan, 1973.

11/ The prevailing price in the fall of 1973 and spring 1974. Prices of diesel fuel rose to VN $125/liter in 1974 but were reduced to VN $95/liter by government actions. VN $125 is U.S. $.58/gallon at an exchange rate of VN $620 to U.S. $1.

Current conditions in the trawler fleet reflect the fuel price problem. In a number of instances fuel costs equaled or exceeded crew salaries. This is a most unusual condition. Total trip costs appear to range from $90,000 to $120,000 per boat per year for large trawlers. The major items of these costs are crew 30-40 percent, fuel 35-45 percent, food 5 percent, ice 5-10 percent, and other costs 5-25 percent. These ranges are rather broad, but reflect the variety in cost structures for different firms. Operating costs for the large trawlers range from about $.13 to $.27 per kg. A trip with a fairly large share of first quality fish could bring $.28 per kg (average price July, August, and September 1973) in the Saigon market.

The cost of producing shrimp ranges from $3.48 to $3.73 per kg.

Profitability of Fishing Operations

The large trawler fleet is not in a financially healthy condition. Obviously, some firms are performing better than others, but even the more successful firms seem to be just breaking even. This is based upon the responses of trawler owners to direct questions as well as an evaluation of their composite costs and revenues. It is also clear that some firms are losing money. The cost of money itself is a real problem for some firms which must pay interest on debts up to perhaps a third of operating costs. While rising costs are a clear problem, particularly the cost of fuel, it is equally important to recall that catch rates are low. Several operators indicated that catches would have to be 30-50 percent greater for operations to break even. "Break even" can be a bit of an elusive concept, but it indicates their concern.

MEDIUM TRAWLERS

Characteristics of Vessels and Operations

These vessels are of a variety of types and sizes ranging from about 20 to 40 G.M.T. They are heavily constructed of wood and are diesel powered. Few of these vessels have sufficient power to trawl singly. At the top of this group, 110 horsepower engines are common, although some have up to 250 horsepower. In the middle of the group, 60 horsepower is common. The smaller boats have 30-50 horsepower. Most of the pair trawlers observed tow from the bow and set and haul forward. Winches are rare and the net is hauled by hand.

Trip length varies by season, location, and size of vessels. Smaller vessels often fish by the day, although at times will make 3- to 4-day trips. Larger vessels in the group will often fish for 4 to 7 days. Trips beyond 7 days appear to be rare. Because of the varying trip length, it is difficult to utilize the number of trips with trip length to evaluate days fished per year. An examination of the records of a fishing cooperative suggests that vessels made month-long trips. Given the lack of freezing equipment, this would not be possible. However, it seems unlikely that vessels of this size with trips of 5 to 7 days would spend more than 200 to 210 days at sea when allowances are made for bad weather and breakdowns.

The vessels do not have electronic gear of any sort and few have compasses, although they can and do operate well out of sight of land. There is evidence of experimentation with gear. New nets being hung in several places were quite different from conventional trawls.

Towing times range from 1.5 to 3 hours and speeds range from 1.5 to 3 knots.

Productivity - Catches

For vessels making 5- to 7-day trips, the reported catches range from 2 to 40 M.T. Typical catches appear to range from 5 to 10 M.T. Often the captains are less concerned with M.T. of fish than gross stock and, when asked about catches, would respond in terms of the gross stock in piasters, not fish in M.T. It is possible that the larger and better boats in this group are as productive as some of the large steel trawlers. A 300 M.T. catch of fish per pair of trawlers per year for good, larger boats appears reasonable. The average for the group would appear to be 110 to 120 M.T. per pair per year.

Vessels landing at the cooperative in Saigon ranged from about 4 M.T. to over 9 M.T. per trip for the sample examined. Some vessels are remarkably more consistent than others; for example, one vessel averaging 4.2 M.T. a trip had a standard deviation of .76 for 17 trips while another with average landings of 4.4 M.T. had a standard deviation of 2. It should be noted that some of these vessels are gillnetters, [12] and it was not possible from the records to make a determination on the type of gear.

Again, it was frequently remarked that a large part of the catch was trash fish. It was not possible to assay precisely how much.

Manpower and Crews

Crews are much smaller on vessels in this group than on the large steel trawlers, as would be expected. Even on the larger boats, a crew of six or seven men is common. Smaller boats would have four men. Sharing of the gross stock is much more common on these vessels than on the large trawlers. The 50/50 share of net stock was mentioned several times. One mention was made of a fixed payment to each crewman per kg of fish caught. The payment depended upon the price of fish.

Operating Costs

Few of the operators of these vessels had a clear notion of the details of their operating costs. It appears, however, that the fraction of costs for the crew is much smaller on the larger vessels in this group because of the smaller crews. Also, given the share systems used on the larger boats in this group with all trip expenses subtracted from the gross stock, increasing fuel costs essentially reduce the crew's share as well as the boat share. Hence, crewmen bear more of the price risk under these share systems. However, under

12/ Gillnetters are fishermen who use a net set upright in the water to catch fish caught in it when their gills become entangled in its meshes.

good fishing conditions, it appears possible that crewmen on the medium and larger trawlers of this group can earn as much or more than those on large steel trawlers.

On longer trips, ice is an important cost since these vessels have no auxilliary refrigeration. On day trips, no ice is used. Trip expenses for fuel, ice, food, and crew run about 75 percent to 90 percent of the gross stock under average conditions.

Operating costs for medium trawlers under average conditions come to about $.13 per kg. This is at the lower end of the range for large steel trawlers. For the smaller trawlers in the group, operating costs are about $.18 per kg.

Profitability of Fishing Operations

At current prices, these vessels seem to be operating at profitable levels. While the rising cost of fuel is a problem and profits are being reduced, there is still considerable activity in boatyards building additions to the fleet. The high cost of engines is preventing repowering of some vessels, however.

GILLNETTERS

The use of monofilament gillnets is widespread among those interviewed with vessels having as much as 10 kilometers (km) of net up to 10 m deep. Gillnetters generally are lower powered than trawlers of the same size. Some 110 horsepower motors appear among the larger boats, but 40 horsepower is more common. Gillnetters, like trawlers, fish both by the day and for extended trips up to 10 days. Day trips often consist of a single set of 3 hours during the late night or early morning.

Gillnets, of course, produce most of the pelagic fish, the mackerels, tunas, bonitos, and similar fish, but also are used for demersal fish when set near the bottom. Pelagic fish tend to be somewhat more seasonal in their appearance than demersal fish.

Crews are about the same size on gillnetters as on trawlers of similar size. Remuneration systems are also similar. However, it is very common among the smaller gillnetters for one or more men to own the net and one man to own the boat. In these cases, the gross stock is shared in different ways, but, in some instances, the net owner's share is greater than that of the boat owner.

Catches, of course, vary with the type of fish and the seasons. Under good average fishing conditions, 7,000 m of gillnet produce 1 M.T. per day as reported by one fisherman. Another reported about 450 kg for 4,000 m as a good day's catch. Still another fisherman reported 250 kg a day as a good catch with 6,600 m of gillnet. The larger gillnetters may produce, on the average, 70 to 75 M.T. of fish per year, and the medium-size vessels about 50 M.T. per year.

The cost structure for gillnetters is very much like that for medium pair trawlers. Operating costs for larger gillnetters appear to range from $.16 to $.18 per kg. Costs are similar to those of the trawlers.

Gillnetters are facing rising costs, as are other fishermen. It would appear that operations are still profitable at present production rates and costs.

SUMMARY OF FISHING OPERATIONS

The purpose of the extensive discussions with fishermen and owners was to determine their productivity and costs more precisely than has heretofore been possible. Given the size of the country and the large number of fishing craft, it was not possible to obtain a large, well-distributed sample. However, certain patterns emerged as the result of these interviews which have been reflected in the review of the situation above.

The production of fish and shrimp by larger trawlers is low relative to the performance of vessels of this size elsewhere in the world. This appears to be attributable to: 1) too little time spent fishing, and 2) relatively low catch rates. The first is a function of marketing problems, considerable travel time, short trips, breakdowns, customs, and crew problems. The second is a function of fishing methods, gear used, captains' skills, and availability of fish.

The medium pair trawlers and gillnetters are relatively better producers. The trawlers, while using what appears to be inefficient gear, are of a size and simplicity that has permitted more effective operation by their masters. Moreover, these medium-sized vessels can fish in most of the places exploited by larger trawlers, but can often utilize ports nearer the fishing grounds both for safety and for landing fish. In addition, since virtually the only machinery aboard is the propulsion engine, breakdowns, while costly, are not likely to be complex or unusually difficult to understand and repair.

The gillnetters generally appear to have the most suitable gear for their operations and to be the best balanced fishing units. Their production is more subject to seasonal movements of pelagic fish than are trawlers. The gillnetters and small trawlers appear to perform with about the same efficiency. The annual production of several groups of these vessels is shown in table 7.

The ranges in trip production for medium trawlers and gillnetters reflect trip lengths from 1 to 10 days. Production of fish per M.T. of fishing vessel averages about 2 M.T. for the large and medium trawlers.

The cost of fishing in Vietnam is not low. The larger trawlers have proven expensive to operate, maintain, and finance. Even the smaller vessels do not produce cheap fish. While operating or trip cost data were obtained from a number of captains and owners, it was not possible to obtain complete (total) cost records for any useful number of vessels in any category. Consequently, costs reported here are only a fraction of total costs. The operating (trip) costs specifically exclude such items as depreciation, financing charges, major

Table 7--Estimated Vietnam commercial fishing fleet production, per trip and per year, 1973

Vessel type	Production/trip	Production/year
	Metric tons	
Large trawlers (pair)...... (90-130 G.M.T.)	20-40	300-500
Medium trawlers (pair)..... (20-40 G.M.T.)	1-15	110-120
Gillnetters................	2-10	30-60

Source: Original data.

repairs, and other items which have little to do with immediate fishing operations. Total costs could be over 50 percent higher than the operating costs reported.

The costs of producing fish under various conditions are shown in table 8. These costs are shown on a per kg basis to provide comparability among vessel types.

Table 8--Estimated Vietnam commercial fishing fleet operating costs costs under certain fuel costs and exchange conditions

Vessel type	Operating costs with actual fuel prices		
	52 VN$/ liter 1/	95 VN$/ liter 2/	125 VN$/ liter 2/
		U.S. $/kg	
Large trawlers........	.22 3/	.27	.32
Medium trawlers.......	.13	.16	.19
Small trawlers........	.18	---4/	---
Gillnetters...........	.17	---	---

Source: Original data.

1/ Conditions in October and November 1973 when the exchange rate was 535 VN$/US$.
2/ Conditions in winter-spring 1974 when the exchange rate was 605 VN$/US$.
3/ The range of costs was $.13 to $.27 per kg; the modal value was near $.22.
4/ Cost breakdowns of the data from these vessels ranged so broadly that calculations with new fuel costs were meaningless.

Despite the range of data, what emerges from table 8 is that the large trawler fleet produces fish at high cost relative to other vessels in the fleet. With increasing fuel costs, the problem is becoming even more severe. Even the smaller vessels are not producing cheap fish. When one further considers the costs not included, it is clear the the Vietnamese fishery is likely to be relatively high cost when compared with other world fisheries.

The cost of producing shrimp by larger vessels in Vietnam is also high at $3.48 to $3.73 a kg. This stems both from low production and high operating costs.

The distribution of costs for the larger trawlers (shown in table 9) is a cause for some concern. The major cost is fuel.

Table 9--Estimated Vietnam fishing trawler operating (trip) cost distribution, fall-spring 1973-1974

Item	Fall 1973	Spring 1974
	Percent	
Fuel	40	57
Crew	35	24
Ice	8 1/	10 1/
Food	5	3
Other	12	6
Total	100	100

Source: Original data.
1/ Ice costs may be significantly higher for the smaller vessels.

The fall 1973 breakdown reflects fuel costs of VN $52 per liter and an exchange rate of VN $535 per U.S. dollar ($.35/U.S. gallon). The spring 1974 figures reflect a VN $95 price for fuel and an exchange rate of VN $605 per U.S. dollar ($.59/U.S. gallon). Despite the fact the diesel fuel prices were not unusually high in the fall, fuel still constituted an inordinate share of operating costs.

MARKETING AND DISTRIBUTION SYSTEMS

PORT ORGANIZATION

An excellent brief review of Vietnamese ports has been prepared by Brouillard, Steinberg, and Floyd. 13/ Brouillard also prepared a comprehensive report with recommendations for market and port improvement in 1970. 14/

13/ Report of Fishing Port Survey Team, K. D. Brouillard, M. Steinberg, and H. Floyd, USAID Saigon, April 1972.
14/ Fishery Development Survey, K. D. Brouillard, USAID, Saigon, April 1970.

Five major fishing ports were evaluated in the first report: Rach Gia, Phuoc Tien, Vung Tau, Nha Trang, and Da Nang. None of these facilities were adequate to the needs of the fleet. The inadequacy of port facilities has required the creation of complex organizations for handling fish, with the concomitant costs.

Several similar papers have discussed the cost of moving fish to Saigon from vessels in several ports. These reports have no indicated authorship. However, the data appear to be approximately correct when checked against the statements of a number of middlemen who were interviewed by the authors.

The cost of porterage and sorting--that is, getting the fish from the boat to the fish stall on shore--ranges from a low of $.02/kg to $.055/kg in Nha Trang. Given the arduous nature of this task, this is a very low cost. The highest cost of $.055 would amount to 3 percent of the selling price of first quality fish, 7 percent of the price of low quality fish, and 5 percent of the price of second class fish. At an average of these charges, the approximate total cost applied to all sea fish would be $20 million; this represents the maximum possible savings in cash cost each year if those services could be eliminated. These charges do not, of course, apply to all sea fish since a large (but unknown) part of the fish is landed at small ports and beaches; even at major ports, some fish avoid the formal channels. Only fish from vessels selling to middlemen for subsequent shipment to other cities or subsequent wholesaling in the port are probably subject to these charges. However, the organization of porters in Vietnam is very strong and, in many ports, has matters under effective control. Of course, even with better organization, many of the services would still be required and to eliminate functions now required at the ports due to lack of reasonable facilities will at best be difficult in some areas. Phan Thiet is a good example of a port area that would require a large investment to provide adequate facilities; even then, the silting problem would probably continue to be severe.

It is obvious everywhere that port development has not kept pace with industry expansion, and Vietnam has very few good ports where fishing is most important. As important as the porter and sorting costs are, perhaps the deterioration of the fish from the repeated handling and exposure to the sun is even more important.

The total cost of moving fish to Saigon is most importantly a function of transport costs. The total cost of moving fish from vessel to Saigon is $.03 from Rach Gia, $.036 from Vung Tau, $.062 from Phan Thiet, and $.066 from Nhe Trang. These do not include the costs of the middleman management. Middlemen in Rach Gia estimated that they needed about $.054 to $.093 margin per kg to break even, or about $.021/kg above the costs listed above since basket, box, and management costs were not included in the accounting procedure.

TECHNICAL CONSIDERATIONS

Handling Systems

A more or less typical operation for getting fish from the boat to the retailer is as follows: fish are sorted aboard the vessel and separated there into

baskets ranging in size from 15 to 50 kg of fish. The baskets are then moved to a middleman or collector's stall or station. This move may require walking in the water for 50 m or more, a sampan trip of a km or so, climbing a steep rocky shore or carrying or carting over land. The fish is then weighed and usually dumped on the ground or floor for further sorting. After this sorting, fish are packed into boxes of 15 to 50 kg or baskets holding from 50 to 250 kg and iced as the packing proceeds. The boxes and baskets are covered and loaded onto trucks, the 250 kg baskets two deep. The truck proceeds to Saigon and is unloaded. The contents of the baskets are dumped onto the floor where they are sorted again, typically separated from ice, and possibly weighed. Upon sale, fish are placed in baskets or boxes, weighed again, carried to a vehicle and transported to a retail market.

While systems vary somewhat from port to port (e.g., Rach Gia uses boxes and 50 kg baskets; Phouc Tien uses boxes; and Phan Thiet uses 250 kg baskets), the essential feature is the number of times fish are handled. In addition, the use of baskets piled atop one another can place extremely heavy pressure on fish at the bottom of the pile.

The nature of the operations in the ports is dictated by the fact that no real port facilities exist, except in Saigon, and these are inadequate.

Cold Storage, Transport, and Other Facilities

An effort has been made in all ports to provide building and wharf space, but, in all cases, it is not sufficient, given the growth of the industry. In Rach Gia there are a number of fish stalls built along the river on a wharf so that vessels unload on one side and trucks can load on the other. There is also space along the bank of the river where vessels tie up to unload and to load provisions, often three or four abreast. Fish stalls are scattered along congested side streets. Much of the fish comes ashore over a sea wall next to which vessels can tie. There is no cold storage in the immediate area, although fish and shrimp processing plants several km away have substantial cold storage capacity.

Vung Tau also has some wharf area, but the fish market building cannot be used. Hence, operations are almost entirely outside except for an open shed and a few small stalls. Fish are carried ashore through the water at one site in Vung Tau and carried up a rocky bank at another. Facilities are inadequate. Cold storage in Vung Tau is not available for fish.

Phuoc Tien has an open shed with a number of stalls. However, there is no useful wharf area. Streets are narrow and difficult to negotiate. No cold stores exist.

Phan Thiet has a number of fish stalls at a short, but convenient, distance from shore. There is a small unloading wharf, but it is not used much, even when it is not silted in. Vessels are tied along both sides of the river at privately provided piles or left at anchor. Cold stores for fish are not available.

Nha Trang also has an open shed, but without stall separations. Removing fish from the shed to a truck is extremely cumbersome. No space is provided for vessels to tie up. Cold stores are not available for fish.

Fish are transported in stake body trucks with canvas or metal covers. With the modest amounts of ice used and the lack of insulation or refrigeration, it is not surprising that the ice has often melted before Saigon is reached.

Ice is generally available and the price of about $10 per M.T. is not high by tropical standards, although it has risen rapidly in 1974 and may be twice the above figure. The quality of the water used in ice making is questionable.

Baskets and boxes are easily obtained and not expensive.

Selling and Buying Systems

Usually a fisherman will sell to the same collector or middleman at the port. His allegiance may be due to his debt to the middleman, or other factors.

The price the fisherman receives is usually not established immediately since most of the middlemen are commission men, not merchants; the middleman acts as a collector. He may pay the fisherman about half the value of the catch and make final settlement 3 days to a week later when he has received notice of sale in Saigon or elsewhere. This settlement will reflect deductions for commissions in Saigon (about 6 percent), transport costs, taxes, and other expenditures. In other cases, the middleman may give no advance, and the fisherman must wait 3 days to a week for the full amount.

Sometimes the middleman will buy the fish outright, though, paying a price agreed to by the fisherman less any amounts the fisherman owes on debts.

All sales and charges appear to be carefully documented. Prices are the result of individual bargaining wherever the sale ultimately takes place. There is no market information system except word of mouth. There is not complete uniformity in prices by species in a port, but, in general, prices among the various agents are similar and fishermen's impressions of prices appear to be fairly uniform. There are a large number of middlemen in each port and, in general, even large buyers or processors use middlemen rather than buying directly from fishermen.

Saigon Market

The Chanh Hung fish market is the focus of marine fish sales in Saigon. It consists of a large open shed, about 150 m of wharf, office space for market administration, the cooperative (Hai Bang), and cold storage facilities. There are about 55 middlemen in addition to the cooperative. The cooperative charges a lower commission on sales (2 percent) than private operators (6 percent). The cooperative's records provide an interesting insight into operations. Since the cooperative operates as a commission man, it cannot pay boat owners until the load is sold. Over 100 separate transactions may be needed to sell 3 M.T. of fish, so each sale is very small. This requires a great deal of record

keeping and obviously a large amount of labor. The cold storage under the control of the cooperative is not used to assist in stabilizing prices.

Private middlemen in Saigon may simply be representatives of middlemen in the country, or they may be the middlemen themselves and have representatives in the country. In any event, they may lend money to both retailers who buy on credit and to boat owners. In addition, they may lend money to independent middlemen either above or below them in the marketing chain in order to assure their loyalty. No doubt there is ample opportunity to control prices to fishermen, although there are enough operations in the Saigon market to assure competition if numbers alone are enough. The range in size of operations is large. Of six middlemen interviewed at some length, the smallest handled only 1 M.T. per day and the largest 20 M.T. on some days. No one middleman is large enough to buy a large trawler load of fish. The middlemen are performing an important function here in accumulating capital for the industry.

The Saigon market, like many others, has a low price elasticity; it cannot absorb large quantities of fish without reduced returns. Access to cold storage is limited. There is inadequate water. It's main function is providing shelter from the rain.

Marketing Margins

In 1968 Thuan, Dan, and Pressler prepared a report on the Saigon fish market. At that time fishermen received 68-69 percent of the retail price during the week examined, wholesalers (middlemen) 10-14 percent; and retailers 19-20 percent.

The situation appears to have changed dramatically since 1968. Fishermen now receive about 36-40 percent of the retail price. The gross margins are summarized in table 10 below.

Table 10.--Fish marketing prices and margin shares in Saigon, fall 1973 1/

Price level	Price	Percent of retail price
	US$/kg	
Retail (Saigon)................	.47	100
Wholesale (Saigon).............	.28	60
Fisherman (country ports)......	.17-.20	36-43

Source: Original data.

1/ These estimates represent data for good quality edible fish.

It was not possible to assay with any accuracy the structure of the wholesale to retail margin. However, it was possible to evaluate the composition of the fisherman-wholesale difference at Saigon and other ports:

	U.S. $ per kg
Official taxes	.010 - .013
Porters in ports	.020 - .055
Transportation	.030 - .066
Port collector - middlemen 15/	.020 - .030
Saigon commissions 15/	.020 - .020
Average range	.100 - .184 16/

Not included in the breakdown above are the so-called "black taxes" which are often borne by a middleman or shared among several middlemen in various ways. In some circumstances, the cost of porters may constitute half the total cost. This is the result of very complex collection systems in ports with wholely inadequate facilities. Moreover, the porters are quite well organized and the charges are not negotiable with individual middlemen.

PROCESSING

The principal processing in Vietnam is in Nouc Mam manufacture and natural drying of fish. 17/ Fish curing, fish meal production, and fertilizer manufacture from Nouc Mam waste are also of some consequence, the potential for fish meal manufacture particularly important. Shrimp processing for export has also become important in value, if not in volume. Fish exports have also grown.

Shrimp

In mid-1973, Colley 18/ estimated that daily shrimp processing capacity in Vietnam was 87 M.T. and with 200 working days (8 hours/day), an annual plant capacity of 17,400 M.T. of finished product was available. Further, based upon a projection of available export shrimp of 21,938 M.T. (live weight), he foresaw excess capacity of 4,237 M.T. It is doubtful that 1973 installations achieved planned capacity. Nevertheless, the system behaved as if there was excess capacity. Prices rose dramatically to as high as $4.11 per kg for large white export shrimp (16 to 20 count and larger) in some places. 19/ Prices generally ranged from $3.45 to $4.11 per kg (head on) during October and November of 1973. Buyers bid prices up to what were, for some, unprofitable levels.

15/ Includes operating costs not included above, such as labor, boxes, ice, and credit costs.
16/ The typical margin in Saigon is probably in the range of U.S. $.08 to .11.
17/ Nouc Mam is the traditional Vietnamese condiment popularly used at most meals. It is a processed fish sauce preferred by Vietnamese to the soy sauce popular in other Asian countries.
18/ Unpublished report prepared for USAID, Saigon.
19/ Exchange rate at the time was 565 piasters per U.S. $.

At the price of $3.45 or VN $1,850 per kg (head on), the raw material cost of a kg of headless shrimp would range from $4.92 (VN $2,637) to $5.39 (VN $2,884) assuming yields of 70 percent and 64 percent, respectively. Obviously, losses such as spoiled shrimp and small shrimp mixed in with large shrimp would reduce yields further. there is a natural loss in grade during processing, as sizes are not uniformly high. One experiment that yielded about 70 percent tails had enough relatively high count shrimp that the margin between raw material cost and selling price was insufficient to cover processing costs. It is probable that most plants are losing money at present prices and scales of operation. Total processing costs are probably ranging from $.90 to well over $1 per kg (not considering loss of weight in processing) for export shrimp for most plants; there is simply no profit at these costs. Even plants that are earning profits are probably close to the break even point.

The price of shrimp received by fishermen in Vietnam is high if one assumes 50 percent of the catch at VN $1,850 and 50 percent at VN $300. The weighted average price per kg is VN $1,075, or $2.01 less 10 percent for commissions and handling, leaving a net of $1.80. Currently, U.S. fishermen average $2.11 per kg and Persian Gulf fishermen $.70. In Mexico the price to the boat is about $1 per kg.

Some shrimp are deheaded on the beaches, some by middlemen, and some on two boats which process on board. Most, however, is deheaded in a processing plant. The two boats equipped to process shrimp on board can freeze 5-pound blocks in export condition. These vessels have mechanical sorters that do not function well at sea and, hence, are not used. A barge with the capacity of 2 M.T. of export shrimp per day began operating in 1973 as well.

Most of the quick freezing capacity in Vietnam is either contact or blast freezing. Several plate freezers are installed, but were not functioning. All of the pans used for blocks were galvanized iron, but several plants had stainless steel work tables while others had aluminum or galvanized iron tops.

Given the variety of sizes and the often poor condition of shrimp, mechanical sorters do not work well. Most sorting is done by hand. There were few aids to materials handling in most plants.

Some plants chlorinate their water supply as it comes from a well while others add chlorine to water in tubs and pans. Some plants use water for rinsing floors and shrimp liberally; others are too conservative. Personnel are generally clean and properly clothed for work in food processing. Whether or not health examinations are required is not clear. Some plants are sorting on floors. While this is an improvement over the ground, it is hardly satisfactory. While many factories are open to insects, there were no flies or other insects observable during the daylight hours.

The shrimp processing plants observed in Vietnam are generally making a real effort to produce a high quality product. Apart from some shortcomings already mentioned, it would appear that the most severe constraint to export is the quality of the shrimp as delivered to the plant. Given the complex collection process, the shrimp may have been sorted and handled several times before delivery

to the plant. In the process, the shrimp may have been warmed to ambient temperatures several times and then cooled again--usually with inadequate ice. Further, the conditions of fish holds of vessels is often appalling. It is doubtful that some holds are ever washed, and, if so, rarely with clean water. Moreover, many day trip boats do not carry ice and deterioration begins almost immediately.

It is customary in many shrimp fisheries of other countries to remove the shrimp head (really the cephalothorax) at sea before shrimp are refrigerated or packed in ice. This is done to avoid the intimate contact of enzymes in the viscera with the flesh in the tail to avoid the development of black spots on long trips and to avoid contamination of the tail with visceral bacteria. However, unless the conditions on the vessel are sanitary and fish holds and ice clean, the potential for bacterial contamination of the tails after deheading may be greater than under present conditions in Vietnam. Also, since most of the shrimp is produced by boats making short trips, the potential for black-spot development is reduced.

One matter that is often neglected in fish processing plants is the cleaning of cold storage facilities and quick freezers. This was not a serious problem in the plants observed, but it could become one if care is not exercised.

The stacking of products in cold storage is another neglected area. Since the products are frozen in solid blocks, the packages will bear very heavy loads and, hence, there is the temptation to stack cartons as high as possible. The master cartons are not indestructible, however, and the lower ones are often damaged, exposing the inner containers to damage as well.

Most of the 5-pound blocks are placed in polyethelene bags, with no identification, for shipment to Hong Kong or Japan. Boxes are also used, however, and the quality of these paper boxes ranges from poor to excellent. This is of little importance if an inner wrapper of polyethelene is also used. Master cartons are another matter. Some are very poor quality and do not withstand the hard treatment they receive in stacking; they also deteriorate from the humid conditions to which they are exposed.

In summary, the shrimp supply conditions in Vietnam, coupled with heavy world demand, have driven the price of shrimp to processors to the point where processing operations are unprofitable. Some processing facilities are on a par with those observed in many tropical areas and others need major improvements.

The quality of the finished product ranges (on gross inspection) from fair to excellent. The quality of the raw material is often poor. It might be useful for management and supervisors of processing facilities to read "Appendix A--Standards for Prawn Shipments to Japan," Export Opportunities for Selected Vietnam Fish Products in Japan, by Steele, Jones, Niehaus, and Dang, U.S. Department of Agriculture cooperating with the U.S. Agency for International Development.

The Fish Meal Industry

Along with other parts of the Vietnamese fishing industry, fish meal production has expanded in recent years. Several plants have been financed with USAID funds and have gone into production (or will soon). It is difficult to estimate planned and present capacity, partly because machinery rarely performs as expected and some machines now in line have not yet had a fair test. It is estimated that installed capacity is 58 M.T. of meal per 24 hour day. This would require 290 M.T. of raw material at the conventional conversion rate of 5 to 1. Planned new capacity plus present capacity could be 80 M.T. of meal per day and 400 M.T. of raw material. For a 300-day year, planned and present capacity would produce 24,000 M.T. of meal and require 120,000 M.T. of fish.

Since plans were made to purchase several integrated processing plants and to expand other facilities, market conditions have changed. The price of raw material has increased and fuel costs have gone up. Raw material (the most critical factor) has increased from $30 per M.T. to more than $50 per M.T. The present cost of raw material per M.T. of finished meal is about $260.

Market conditions for the finished product have changed as well. Prices received by Vietnamese producers ranged from $320 to $350 per M.T. of meal in the fall of 1973. Under present conditions, fish meal production for export would appear to be fairly profitable. An estimate was made by one operator that, at a raw material cost of VN $30 ($.056) per kg, fish meal operations would just break even at present prices. This implies total production cost of something near $40 per M.T. This is somewhat high, although it may also reflect the fact that few plants are operating at anything near capacity. 20/

The situation arising in the fish meal industry is not entirely unlike that for shrimp. Producers competing with one another can force the price up. To some extent, this is now occurring, although not as rapidly as for shrimp. The fish meal plants are not only competing with one another, but with conventional air drying of low value fish. The traditional methods have some advantage in that these enterprises can operate almost anywhere. However, conventional methods do not produce an adequate animal feed.

Nouc Mam is also manufactured from fish selling in the range of VN $25 ($.047) to VN $30 ($.056) per kg, although there is a strong preference for certain sardine or herring like fishes. Except for Phu Quoc, competition between Nouc Mam and fish meal manufacture is not required to be direct.

The problem for present producers, and for future potential, relates to supplies. With the concentration of fish meal production at three sites--Phu Quoc, Rach Gia, and Vung Tau--it is obvious that trash fish must be concentrated at these points. The costs of concentration can be important. For example, the apparently small charge of VN $1 per kg paid suppliers to deliver fish to a plant translates into $9.35 per M.T. of finished product.

20/ By the spring of 1974, fish meal operations had declined even further. Raw material supplies were inadequate and plants were operating at 20 to 30 percent of capacity. One plant ceased operating in the fall of 1973.

A plan that has been developed to increase supplies would locate barges at strategic points in the Gulf of Thailand to permit delivery of fish that might normally be discarded. Hopefully, these fish would cost less than those purchased at the port. The price difference of, say, VN $4 per kg would provide a margin for transportation to shore and delivery to the plant. An annual volume of 40,000 M.T. of fish at this VN $4 price difference would provide about $450,000 a year for operatons. However, at this rate of 200 M.T. a day, several carriers would be required to deliver fish to Rach Gia. These could not be large because of the condition of the port and the very shallow waters. A margin greater than VN $4 would likely be required to maintain a complex organization at sea.

Exploitation of assumed large pelagic stocks in the Gulf provides another possibility for increasing supplies. These stocks are apparently farther out to sea than the areas intensively fished at present; consequently, the trips would necessarily require several days at sea from Rach Gia as well as ice or refrigeration. Ice at the rate of only .3 kg for each kg of fish would cost over $11 per M.T. of fish meal. A boat costing $20,000 a year to operate would have to produce about 500 M.T. of fish to break even.

While an unexploited resource may exist in new stocks, thousands of M.T. of fish are also dumped at sea by boats that make longer trips. A system that would utilize this waste would help the industry considerably in the Gulf.

Other Food Fish for Export

Red snappers constituted more than 10 percent of the catch in the Gulf and more than 14 percent of the catch off the Delta in explorations by the Kyokuyo Co. Snappers could provide a useful export adjunct to shrimp. The facilities for shrimp processing are not so specialized that fish could not be handled as well. The differences between present Vietnamese prices and Japanese prices appear to provide an adequate margin for profitable export.

The same problems of collection exist for red snappers, hairtails, threadfin, and similar fish as exist for shrimp and trash fish, however. Some of these fish are being frozen and exported, but effective marketing depends upon steady, high-quality supplies. Such supplies depend on dependable catches, an efficient collection system, and adequate cold storage. The most notable shortfall is the collection system. For example, if present marine catches contain 10 percent red snapper, Vietnam would produce over 50,000 M.T. per year; this is not likely. And, it is doubtful that exporters could command more than 10 to 20 percent of such a catch because the poor collection system would not yield the good quality required for export.

Trawling is not the most effective method for snappers since they concentrate in rocky and other untrawlable grounds. A troll or other hook and line fishing methods concentrated on snapper grounds would simplify the collection process by having catches with higher proportions of snappers. It should be noted, however, that even such apparently inefficient gear as hooks can be sufficiently effective in snapper fisheries to reduce catches rather quickly. Hence, a concentrated effort on snappers could produce high initial yields but subsequent declines if not carefully managed.

Cuttlefish and squid are currently being processed for export. The product appears to be of excellent quality. Because of heavy fishing for demersal fish in the Gulf, squid populations have increased in the area and provide a base for production expansion. This would require fishing nearer Thailand than Vietnamese boats now go.

The larger number of fish species in tropical areas has always presented problems in segregating desirable species. It also makes it difficult to provide the special care that would be desirable with fish for export. The mixed catch tends to be all treated alike. The quality problems may be even more severe for fish than for shrimp since, even where ice is properly used, it takes longer to reduce body temperatures of fish to desired levels than it does with shrimp. However, quick cooling of tropical fish actually inhibits bacterial growth more effectively than it does in temperate areas.

<u>Nouc Mam, Fertilizer, and Other Products</u>

Nouc Mam production is concentrated in Phu Quoc, Phan Thiet, and Nha Trang, although it is produced elsewhere as well. Production has expanded rather consistently. It is not clear whether new capacity has been added, more water has been added and protein reduced, or the length of aging has been reduced. All of these practices could contribute to increases in output. The quality of Nouc Mam depends upon the quality of the raw materials, fish and salt. These are mixed in a ratio of about 1.2 M.T. of salt to 5 M.T. of fish. Sardine- and anchovy-like fishes are preferred. Also, the aging process contributes to clarity, taste, and quality generally. Usually, the longer the aging the better, with the process varying from 3 months to a year. It is not clear that great improvement is realized beyond 9 months.

Producers sell under private labels and at wholesale. There are grade qualities for all price ranges.

Although the official statistics indicate an expansion of the industry, no evidence of new capacity was observed in the ports visited. Phu Quoc, however, was not among those visited.

The residue from Nouc Mam is used in fertilizer manufacture. [illegible] is added to the residue and the mixture stored for several months. After [illegible] drying, the mixture is ground and bagged. The product is used chiefly for fruits and vegetable production. Other fish products are also used for fertilizer, but these processes were not observed.

Drying fish for human as well as animal consumption is extensive. The sun dried edible fish are dried on racks in the streets. This use of fish can reduce market fluctuations somewhat since it creates a storable commodity. Obviously, it cannot be pursued during rainy periods.

One company is experimenting with artificial drying systems of several kinds and produces a product superior to the air dried variety. This firm also has equipment for smoking and mincing. In time, these efforts should prove a useful adjunct to fresh fish marketing, provided raw materials are readily

available. The packaging of these products in attractive polyethelene bags provides excellent protection in the market.

There are a variety of other fish products that play a minor role in the industry, but none of these, or even those above, is crucial to fisheries development. It is expected that each will continue its contribution with some expansion, except for air drying fish for animal feed.

SUPPLIES AND SUPPLY POTENTIAL

The most recent assessment of demersal stocks in the South China Sea and the Gulf of Siam is contained in A Trawling Survey of the South China Sea and the Gulf of Thailand (hereafter noted as A Trawling Survey...). This report is based on 3 years of trawl survey work (1969-1971) for the Vietnamese Government by the Kyokuyo Co., Ltd., of Japan.

There also exists a preliminary draft report on pelagic fishes entitled Pelagic Fishery Resources of the South China Sea, Prospects for their Development (hereafter referred to as Pelagic Fishery Resources...) by D. Menasveta, S. Shindo, and S. Chulasorn. This report is undated, but undoubtedly completed in 1973. This report is not based upon any newly developed catch information, but upon a review of the literature available regarding catches.

Given the lack of precise information relating to growth rates, mortalities, stock addition rate, etc., for various species, it is, at best, difficult to assess potential yields. Furthermore, one is pressed to aggregation and use of rather crude estimating procedures for standing stocks and possible yields. Often these estimates depend upon the feasibility of extrapolation from one region to another (perhaps the least satisfactory approach) or projecting from catch rates either obtained commercially or by research vessels. The latter approach requires rather impressive assumptions concerning the effectiveness of gear and, ultimately, mortality rates. Comparison with similar or nearby areas sometimes permits approximate evaluations of these methods.

Obviously, an estimate of the weight of the standing stock alone is of little value when considering a long-term investment with little mobility. In consequence, attention is typically on potential yields from those areas and those types of fish relevant to development issues in Vietnam, as it will be in this report. Even a potential yield figure is of little importance unless it is economically feasible to harvest it. Fish are not homogeneously distributed, and only in areas of relative abundance may harvesting be profitable.

DEMERSAL FISH

Demersal fish are those in contact or close proximity to the bottom. Many of the demersal species around Vietnam are highly valued, both at home and abroad. Among these are the red snapper, pomfrets, and threadfins. Typically, demersal fish are either caught with hooks and lines, gillnets set near or on the bottom, and trawls. In Vietnam there are a number of other ingenious systems for trapping and netting them as well.

In this paper, the trawling activities will be emphasized for several reasons: (a) the trawl fishery has developed dramatically in recent years; (b) increased production will depend upon the greater range and flexibility of trawlers;

and (c) it is virtually impossible to evaluate productive effort of many other fishing systems without more extensive study.

The fishing grounds of particular importance to Vietnam are the Gulf of Thailand and off the Mekong Delta. These grounds, of course, have been exploited for some time. Estimates published in 1970 suggested a potential annual yield of 1.05 to 1.3 million M.T. 21/ of demersal fish from these grounds. However, the area considered as belonging to the Mekong Delta fishery was smaller than that used in A Trawling Survey.... Gulland's estimated potential, if expanded to the larger area, would provide another 325,000 M.T. rather sparsely distributed over 200,000 km. Hence, the estimated potential for the same area as that in A Trawling Survey... is 1.4 to 1.6 million M.T. on 155,200 square nautical miles or 531,600 km. Present catches in the area are estimated to be about 850,000 M.T., providing a potential increase in yield of 525,000 M.T. or more. The production estimate is based on the assumptions that 45 percent of Vietnam's demersal catch comes from the area (45 percent is the average share of total marine fish catch for regions III and IV) and that 50 percent of the Thai catch came from the Gulf.

Reducing Gulland's estimated potential by the stocks in untrawlable waters (as reflected in A Trawling Survey...) would lower the estimate to .954 to 1.11 million M.T. On the basis of these potential projections, it appears that the trawlable areas of the Gulf and Delta are fairly heavily exploited. This is certainly the case with the coastal areas of the Gulf of Thailand and certain areas along the Vietnamese coast.

Recent estimates from A Trawling Survey... suggest that there are demersal stocks of more than 1.1 million M.T. in the trawlable grounds in the Gulf and off the Delta, most 20 to 40 miles offshore. On all ground (trawlable or not), stocks would be about 1.446 million M.T. of demersal fish. If stock density in the zone from 0-20 miles from shore along the Vietnamese coast is assumed to be twice the stock density over the whole of trawlable grounds beyond 20 miles, and if stocks within 12 miles of the Cambodian and Gulf Coast are added, we get estimates of 1.581 million M.T. on trawlable grounds and 1.921 million M.T. on all grounds.

So a question still remains concerning what fish are there. However, interviews with large steel trawler owners and captains concerning footrope and headrope lengths, towing speed, towing time, and catches made it possible to construct an independent estimate for the Gulf of Thailand. This estimate suffers from its small sample properties, but using the formula used in A Trawling Survey... gave estimates of standing stocks in the Gulf of 529,000 M.T. in the area over 20 miles for Vietnam and over 12 miles from Cambodia and Thailand. The estimate from A Trawling Survey... was 528,000 M.T. for the same areas.

21/ The Fish Resources of the Ocean, J. A. Gulland, ed., FAO Fisheries Technical Paper 97, Rome, 1970, p. 142.

The close agreement is neither cause for elation nor despair. It does suggest, however, that the trawling vessels and equipment being used by the Vietnamese fishermen are performing similarly, and that the Kyokuyo Survey gave a useful measure of performance of trawlers as well as an adequate measure of standing stocks and yields.

Several other factors need to be considered in these estimates. Harris Magnusson 22/ has aptly pointed out that the trawl may miss stocks in midwater even though the fish are indeed there since several species move up and down in the water column diurnally or in response to temperature changes. Bottom trawls would, of course, miss these fish as well, but other fishing techniques might be able to capture them.

Another consideration is that many grids in the Kyokuyo Survey showed only a single haul. These cannot be used to identify good or bad fishing areas. In fact, the entire report has a peculiar distribution of hauls; grid 64, for example, had 44 hauls. Of course, the number of hours actually fished would help judge the sampling a bit better.

The heavy duff areas 23/ also present a problem since the net will not perform in the same way when full of sponges. Experience of Vietnamese fishermen suggests that these duff areas, although difficult, are productive.

The rocky, untrawlable areas are often productive either to gillnets, hook and line, or traps, and may provide a resource greater than that on trawlable grounds; these standing stocks may be underestimated.

If we return to the adjusted Gulland estimate of .954 to 1.11 million M.T., and the stock estimates from A Trawling Survey... of 1.581 million M.T. on trawlable grounds, one needs to consider if they are comparable. Using the equation from A Trawling Survey... produces an estimate remarkably close to the adjusted Gulland estimate:

$$\text{Potential yield} = \tfrac{1}{2}\,(r - M)\ \text{standing stock}$$

$$\text{where } (r\text{-}M) = (1.6 - .4) = 1.2$$

or

$$948{,}600 = .6\ (1{,}581{,}000)$$

In the equation, r(1.6) is the rate of reproduction and M (.4) is natural mortality. Obviously, the estimates are sensitive to the parameters used. Recall this represents resources only on trawlable ground; if total area is considered, A Trawling Survey... gave potentials of 1.152 million M.T. where Gulland's lower adjusted estimate is 1.374 million M.T.

22/ Personal communication.

23/ Duff areas are portions of the ocean bottom supporting large populations of sea life such as sponges, seaweeds, corals, etc., which foul trawl nets and decrease fish catches.

Neither number is magic, but between them they suggest that the present 850,000 M.T. production is not seriously pressing total resources in the area. The lower estimate of 1.152 million M.T. could mean that another 300,000 M.T. or more are available, although these could be distributed over 531,000 km.

From the following summarization, note the similarity between Gulland's estimates and these based on A Trawling Survey...

•Estimations (by source and type)	Potential yield (million M.T.)
Gulland (1970)	
Original	1.050-1.300
Adjusted to larger area	1.375-1.635
Adjusted to trawlable ground	.954-1.110
A Trawling Survey...(1973)	Standing stock (million M.T.)
Total ground	1.446
Adjusted for coastal area	1.921
Trawlable ground	1.106
Adjusted for coastal area	1.581

•Potential yield from trawlable ground (based on A Trawling Survey...)

.6 24/(1,581,000 M.T.) = 949,000 M.T.

•Potential yield from all ground (based on A Trawling Survey...)

.6 (1,921,000 M.T.) = 1,153,000 M.T.

•Summary

	M.T.
Potential yield from trawlable ground	950,000
Potential yield from total ground	1,200,000
Approximate present catch	850,000
Difference	100,000 - 350,000

The Gulf of Thailand has substantially higher catch rates than the Mekong Delta area and also higher stock estimates (about 26 kg/ha as opposed to 19 kg/ha off the Delta). Yet, since the introduction of trawlers to the Gulf, catch per unit of effort has declined markedly to the point where relatively little more can be expected from Thai coastal waters.

24/ See page 55.

In Vietnamese areas of the Gulf, fishermen and captains in Rach Gia indicate declines in catch per unit of effort during the past 5 years. Of course, a decline in catch per unit of effort is expected when one moves from a relatively unexploited to an exploited state since the average size of fish caught declines. However, it is clear that the fishery is under some pressure. With the rapid development of the fishing industry of Vietnam as shown by the increase in size, power, and number of boats in the past 10 years, it would be surprising if some stocks were not heavily exploited.

Comments similar to those in Rach Gia were made in all communities visited. Further, it is clear that fishermen have moved from conventional nearby grounds to more distant grounds as the activity has increased. The mobility afforded by power has made this feasible. However, there are limits to the range and sea keeping ability of the present artisanal fishery, and further expansion in some areas could result in future erosion of profitability. The security areas affecting some 30 percent of the coastal waters of Vietnam are doubtless underexploited and could provide some added opportunity.

PELAGIC FISH

Gulland estimates that there are 1 to 5 million M.T. of pelagic standing stocks in the Gulf of Thailand, with a potential yield of 100,000-200,000 M.T. in waters 50 m or less in depth. Added stocks doubtless exist in deeper waters. The more recent report, A Pelagic Fishery Resources..., estimates a standing stock of 1.037 million M.T. in the Gulf, with a potential yield of 415,000 M.T. (262,000 M.T. now exploited). The stocks off the Delta are estimated at 1.383 million M.T., with a potential yield of 553,000 M.T. (188,000 now caught).

The density of pelagic fish is estimated to be about .58 kg per ha off the Delta and .34 kg per ha in the Gulf. The Delta area is about 236,000 m^2 and the Gulf area 304,000 m^2.

These stocks produce about 450,000 M.T. at present, compared with the estimated potential of 968,000 M.T. This suggests an added possible production of about 500,000 M.T. distributed over 540,000 square km. However, pelagic stock are generally much more unevenly distributed. Schools of fish follow nutrient availability and temperature conditions. Hence, one finds large concentrations at one time and place and nothing at other times and places. The sardines, mackerels, and tunas now exploited belong to this group. While their behavior is seasonal, they do not behave as anchovies, pilchards, and herring; they are more local in their behavior.

These estimates of pelagic fish supply potential in the Gulf of Thailand and off the Mekong Delta are summarized below (the Gulland estimates are not used in calculating potential yields but are included here to provide complete information):

Source and type of estimate	M.T.
Gulland (1970)	
Standing stock	1-5 million
Potential yield	100,000-200,000
Pelagic Fishery Resources... (1973)	
Potential yield (Mekong Delta)	566,000
Potential yield (Gulf of Thailand)	380,000
1971 reported catch	
Mekong Delta	188,000
Gulf of Thailand	262,000
Potential additional yield	
Mekong Delta	378,000
Gulf of Thailand	118,000
Total	496,000

SHRIMP

Data on shrimp reported in A Trawling Survey... are not useful. In fact, a careful exploration for shrimp is recommended. Present unprofitable shrimp operation of large trawlers can stem as much from lack of intelligence concerning the shrimp stock as from inefficiency. Some catch rates are so low that they cast serious doubt on the resource exploited by the larger trawlers. Others, however, are in a range that supports profitable operations elsewhere.

Obviously, the most relevant grounds are near shore at depths less than 50 m. These need more effective exploration before an estimate can be made. Given the limited experience of the large trawlers, however, it is safe to say that shrimp production could be increased.

FEASIBILITY OF EXPLOITATION

In the discussion of potential yields and stocks, the point was made that, however large a potential yield might appear, its distribution might be such as to preclude profitable exploitation. Hence, the problem exists of assessing the possibility of exploiting parts or all of the standing stock.

Productivity of a fishery is often described with a functional relationship between catch and effort, where effort is some function of vessel size, power, time at sea, or fishing gear. We do not have such statistics available for the Vietnamese fleet and, hence, such analysis is precluded. However, A Trawling Survey... did report catches per hour of fishing during exploration; this provides some measure of relative abundance in the sectors fished. In fact, A

Trawling Survey... classified grounds that produced more than 138 kg per hour as good fishing grounds, and those with rates less than 48 kg per hour as poor grounds.

A catch rate of 48 kg per hour for a medium trawler (50 G.M.T. or more) under typical Vietnamese fishing schedules would yield a gross revenue of $18,300 in a year. A much more rigorous fishing schedule (not uncommon in the rest of the world, but rarely used in Vietnam) would yield $46,700 at this production rate. Food, fuel, and ice alone would cost about $20,000 per year on a relatively modest trawler, so under normal regimes these would indeed be poor grounds. Even under the rigorous regime, profits could not be made.

A larger trawler typical of the steel trawlers now in operation, operating singly would produce a gross stock of $110,000 under a rigorous regimen at a catch rate of 148 kg per hour. Few vessels have been able to achieve this gross stock. A few pairs of trawlers come close. A gross stock of this size for large steel trawlers (90 G.M.T. or more) is, in general, not economically feasible. Hence, even grounds producing 148 kg per hour would not be profitable for larger vessels.

Magnusson has indicated that the average catch of the large Vietnamese trawlers is about 2.2 M.T. per G.M.T., and that this is lower than the 3 M.T. per G.M.T. that is common elsewhere for profitable fishing.25/ The Vietnamese trawler example above (148 kg per hour) works out to about 2.6 M.T. per G.M.T. and would not be profitable under present conditions. However, it should be noted that the Taiwan fishery operates successfully on catches of 2.2 to 2.4 M.T. per G.M.T. of vessel.

Of the maximum demersal potential of 350,000 M.T., it is doubtful that more than a third would be economically exploitable. This is on the premise that the efficiency of the fleet exceeds present standards.

It is difficult to assay how much of the 500,000 M.T. potential added yield to pelagic fish can be captured. However, to exploit this potential would require new and expensive technology. The search becomes a critical part of the pelagic fish operation; the more boats developing intelligence on fish locations, the more effective the search. Purse seining (among the most likely fishing techniques) is not easily pursued by a small number of vessels on stocks whose behavior is unknown. Probably less than 50,000 M.T. of the 500,000 M.T. added potential can be captured, then, unless some unusual stocks have completely escaped notice during the past 20 years.

In summary, landings in Vietnam could probably be increased 150,000 M.T. with improved gear and technology. Greater increases in production would depend upon improved intelligence on the behavior and abundance of pelagic stocks.

25/ Personal communications.

CONCLUSIONS REGARDING EXPLOITATION FEASIBILITY

The Vietnamese fishing industry has expanded rapidly in the past 10 years; both fleet size and production have doubled. The export shrimp industry has grown in recent years and, given world demand conditions, shrimp and fish exports could expand further.

A number of large steel trawlers have been added to the fleet recently, and are producing both fish and shrimp. These large trawlers have not been uniformly successful. Several difficulties have been encountered, but ineffective fishing with consequent low productivity and high production costs are two critical factors. Earlier efforts to operate large trawlers in the South China Sea and the Gulf of Thailand have failed to be profitable as well.

Shrimp production has not kept pace with the expansion of processing facilities; consequently, the competition for shrimp of export size and quality has driven prices so high that some processing operations are no longer profitable. For those that are still profitable, the profit margins have declined by 80 percent.

Large numbers of small shrimp that could grow to export size indicates that shrimp resources are heavily or inefficiently exploited. A significant problem in exploiting shrimp is the lack of information on their behavior; fishing can be quite erratic. Production could probably be increased, but increased efficiency would be required. For the present, the break even point for large Vietnamese trawlers may be as high as 50 M.T. This is unusually high when compared with U.S. and Mexican fleets.

Fish meal manufacture has developed within the past few years, and the capacity now on line or planned will create a situation similar to that in shrimp. The supply of fish for meal is not adequate for the efficient operation of present plants. A 25 to 30 percent increase in the cost of fish to processors would probably make fish meal production unprofitable, even at reasonable production levels.

Fish for fish meal requires special attention. Substantial quantities of industrial fish are apparently discarded at sea. Catches may run 5 M.T. of industrial fish to 1 M.T. of market fish. Exploratory fishing has not borne this out, although what was classed as miscellaneous fish could well have been industrial type and quality. To operate present and planned processing plants could require 120,000 M.T. of fish each year. To produce this raw material will require a new approach. One program for collecting industrial fish at sea has been developed for the Gulf of Thailand. Some system will also be required off the Delta for effective fish meal operations.

Vietnamese coastal resources are heavily exploited. If one considers coastal area to extend 67 km (40 miles) from shore, there is one boat for each 1.85 km^2. Catches (in M.T. per trip) have declined in the past 5 years, and the size of fish caught has declined. Similar conditions have developed on the Thai coast, forcing the Thai fleet to forage farther from their own coasts. Some coastal waters in restricted areas are effectively unexploited, however; these grounds could provide shrimp.

Demersal fish production could probably be increased by several hundred thousand M.T., but this increase would necessarily come from new grounds. This would require large trawlers (65-85 ft.), either of wood or steel. It is not obvious that catch rates for fish are high enough to support them.

Vietnamese fish prices are high, comparing favorably with ex-vessel prices in the United States. Shrimp prices are, in fact, higher than in the United States at times. Fish prices have not risen dramatically since 1960, however. Undoubtedly, the rapid increase in production has held down potential price increases.

Despite the high prices, much of the fishing industry is only marginally profitable. Large expensive vessels are particularly problematic. Fuel costs have risen rapidly and, in many cases, fuel costs are as high, or higher, than crew costs. Vietnamese crews are large for the size of most boats, but total wage payments constitute about the same fraction of total expenditures in many less developed countries (20 percent).

Vietnamese fishing technology is varied. Ancient and ineffective techniques are used beside the most sophisticated methods. Synthetic twine and rope has virtually eliminated vegetable fibers in all techniques, however. It appears that much of the trawl gear is unusually heavy and it is doubtful that it fishes efficiently. Poor fishing of the gear could result from inadequate towing speed due to net and twine size and poor opening of the trawl.

Gillnetters appear to be equipped with appropriate gear. Larger steel vessels are equipped with adequate electronic gear for navigation and fish finding. Other vessels, however, have no fish finding gear and most have no compasses.

Processing technology for shrimp and fish meal is in some instances superior to international standards. In other cases, it is inadequate. Some edible fish is frozen for export and the products appear excellent. The major difficulty in the processing sector is adequate supply, obviously a major consideration in developing exports. Transport of frozen fish and shrimp is the virtual monopoly of Sealand, and containers are difficult to obtain at times.

The marketing system is complex and costly. Some of this complexity is a function of the organization, or lack thereof, of the ports and marketing facility. No major fishing port is adequate to the needs of the fishing fleet, but improvements could be very costly because of the nature of the ports. The principal market, Saigon, is inadequate as a city market in almost every respect, from organization to sanitation.

Marketing margins are similar to those in the United States. A 1968 study indicated marketing margins (fisherman to consumer) of about 30 percent of the selling price. Present gross margins are probably nearer 70 percent. Serious questions have been raised about the operations of middlemen in controlling prices, and their role in financing fishing operations and development. In many cases, loans are used as competitive devices to secure adequate supplies from the fishermen. The same device is used to secure the allegiance of other middlemen and of retailers who buy on credit. Obviously, these credits give the

middleman control he would not otherwise have. Whether or not this power is used can be, and is, argued. However, it must be remembered that the middleman is sharing substantial risks in lending to others. The actual commissions charged are not exhorbitant.

DEVELOPMENT POLICY

Development of Vietnam's industry is frustrated by shortcomings in three major areas: 1) technology, 2) policy, and 3) infrastructure. These often overlap. A typical example is the policy that prevents the extensive use of marine compasses, navigation charts, and electronic gear such as short wave radios and fish locating sonar. This equipment is absolutely essential in any modern fishing enterprise. The policy prohibits Vietnamese fishermen from navigating to and locating sizable fish populations effectively, and puts them at a competitive disadvantage with fishermen from other nations.

Lack of radio communication makes even a small mechanical failure at sea a major catastrophe, and prohibits exchange of information and help between boats. Resupplying boats at sea is most difficult, and the frequent return trips to home ports reduces productivity significantly. Furthermore, since all but a few hundred of Vietnam's fishing boats are small (less than 30 G.M.T. capacity) and have no navigation or communications equipment, they tend to stay very close to port. This has led to significant overfishing, catches of small juvenile fish, and a degree of counter-productivity relative to fish populations in these areas.

Facilities and infrastructure at the various fishing ports are woefully inadequate. Sanitation, i.e., potable water and sewage disposal systems, does not exist; wharfs and protected storage areas with adequate refrigeration do not exist. Ice is available at most of these ports, but it is often contaminated, in limited supply, and at prices so high that they discourage its proper use. Modern, reliable scales and weights and measures are not available. Market information, including prices, quantities being bought and sold, and information from other markets is known only by a few middlemen.

Present fuel and ice prices are at least double what they were in 1972, while export and domestic prices for fish are only modestly above the 1972 levels. This has worked a significant hardship on all boat owners. Whether a change in governmental policy relative to fuel and ice prices can help alleviate this hardship is open to question, but should be investigated since these two items account for 35 to 55 percent of the total operating costs at current prices.

There is a serious shortage of manpower trained in modern fishing methods and the use, maintenance, and repair of modern fishing gear. A number of the larger boat owners thought that improved vocational-type training should be undertaken by government. Government could logically do this, using tax revenue, at one or two regional training centers. Present policies that prevent the extensive use of navigational charts, short wave radio, and electronic navigational and fishing gear should be scrapped and the improved navigation and communications methods taught in training programs along with seamanship and repair and main-

tenance skills. Students should be exposed to basic fishing methods, use and repair of fishing gear, elements of food sanitation and preservation, and elementary marine biology. The goal is not to train masters and first mates, but to develop a pool of skilled crewmen, to upgrade technical competence, and, hopefully, to improve operational capability and profitability within the fishing fleet.

Providing improved port and wharf facilities, sanitation, power, refrigerated storage, and handling equipment at four or five major ports is a much more comprehensive and costly issue than establishing training centers. The task must be done, however. Facilities do not have to be sophisticated, but they do need to be planned with care and designed for flexibility and future expansion. Repayment of construction financing costs and payments for normal operation and maintenance of such facilities could be done through modest user charges. This would require record keeping and an administrative mechanism to ensure equity through full collection of fees. If properly established, however, this might also form the nucleus of a much needed market reporting system.

The most discouraging part of the study for the team was awareness of the system of "fees" imposed on fishermen, boat owners, truckers, and other middlemen by dishonest elements. Demand for such payments is growing. These costs are forcing artificially high prices; they are non-productive, and somehow must be stopped if the industry is to grow.

In addition to revenue monies lost because of bribe payments, long delays at "checkpoints" or during "vessel and cargo inspections," lead to quality deterioration of fish products and other operational costs of a negative nature. The comment is often heard that this "squeeze" or bribery has always existed. There are indications, however, that the problem is far greater now than it was as recently as 10 years ago.

A final policy problem which inhibits growth of Vietnam's fishing industry relates to governmental orders declaring large areas of coastal waters closed to all fishermen. This has been a security policy growing out of the hostilities of the past decade. In effect, large areas adjacent to the coast in the South China Sea as well as the Gulf of Thailand have not been fished commercially for nearly a decade.

It would seem logical to assume, in the absence of definitive data, that substantial populations of harvestable fish live in these waters. This is based on commercial catch information from boats which have been intensively fishing open waters adjacent to the closed areas. The industry must be permitted to fish these waters if the commercial catch by Vietnamese boats is to continue to grow. Security conditions in the mountainous coastal areas adjoining many of these waters are still serious; however, policies can be made which will permit commercial fishing to be carried out without jeopardizing security in the area. Hopefully, this can be done so that tedious cargo and vessel searches, long delays, and bribery harassment are kept to a minimum.

PROJECTION OF 750,000 M.T. BY 1980

Trawl Fishery

A production of 750,000 M.T. by 1980 implies an increase of about 150,000 M.T. over the next 6 years, or about 25,000 M.T. per year. We will assume that all of this increase will be attributed to ocean production of marine fish, shrimp, and other species.

Some of this increase can come from improved efficiency in present operations. This can be attained with better gear, use of fish finders, improved vessel design, increased power, improved port facilities, and other improvements. Production increase of .2 M.T. per G.M.T. of boat per year would add almost 29,000 M.T. to output using present motorized vessels over 5 G.M.T. If only vessels over 20 G.M.T. were to increase production by .2 M.T. per year, they would increase production 11,400 M.T. An increase of .2 M.T. per G.M.T. of boat represents about 10 percent of the present productivity. To obtain this increase with additional vessels would require a $5 to 10 million investment, depending on type of boat; at least half of this would be foreign currency.

The potential production from increased efficiency would not come entirely from presently exploited grounds. As has been pointed out, the grounds near important fishing ports are already heavily exploited.

Improving productivity of the present fleet will require about 2,200 vessels of 20 G.M.T. or more; almost half of these are from Vung Tau and Rach Gia. The 8,800 boats in the 5 to 20 G.M.T. group are more widely distributed, and more difficulty in improving performance would be expected.

Wholely apart from changes in methods and gear to increase production is the problem of increasing the number of days fished and the number of days at sea.

Fishing patterns of smaller vessels fishing near home ports are dictated by weather and custom. Larger boats that make trips of 10 to 14 days, and are forced to stay in port 4 to 8 days due to marketing difficulties or custom, are not operating effectively. Vessels with insulated holds and plenty of ice can manage 21-day trips without undue spoilage. An extension of trip length by 5 days, from 15 to 20 days, without increasing total days at sea could increase output by 10 percent. This, of course, assumes the fuel capacity to do so. It is doubtful that hold capacity is limiting at the catch rates observed.

Another possible change would be to provide the capability for single side trawling. In this case, when one vessel of a pair returned to shore, the other could continue fishing. The cost of providing two additional single trawls with doors and gear would probably not exceed $2,000. However, without radio and navigation equipment, locating one another at sea would be a problem.

It is assumed that 20,000 M.T. more could be produced by the present fleet (and it would certainly improve their earnings position), but 130,000 M.T. would have to be produced by new vessels. It would also be necessary to assume that the new vessels were more efficient than present vessels and could produce, say, 4 M.T. of fish per G.M.T. of vessel. While this may be a necessary condition, it may be difficult to achieve except with more days at sea and more efficient techniques. At this level, vessels would be profitable, as operating costs per pound of fish would be about $.15 compared with the average for large trawlers of between $.13 and $.27 currently. At 3 M.T. of fish per G.M.T. of boat, the production costs would average about $.21 a pound now; at 2 M.T. per G.M.T., the cost would be around $.30 per pound.

Even under excellent circumstances, only early additions to the fleet can expect the high catch rates suggested. Productivity would decline and distances increase as pressure develops on the stocks.

It seems doubtful that more than 200 additional vessels of about 50 to 60 G.M.T. could operate profitably in an expanded fishery under present cost conditions and assuming a high level of operating efficiency. These vessels, if of the 70 feet, Gulf-type shrimp trawler, can be rigged for bottom fish trawling with relatively little difficulty and provide the flexibility desired for both single and pair trawling as well as shrimp fishing. With minor modifications, these vessels could also be used for seining. However, these vessels, even if ordered in large numbers, would be costly. For example, the delivery cost of such vessels from the United States could amount to almost 20 percent of purchase price.

Local fabrication with wood or steel would be highly desirable. The potential cost of $36 million for 200 boats would be almost halved if the boats were locally built of wood; it could be reduced by 20 to 30 percent if locally built of steel. The present design of wooden vessels leaves a great deal to be desired, however. The sturdiness and workmanship are generally good, but more careful planning would be essential for more efficient fishing. Present designs also create a great demand for timbers with natural bends or knees. These are often in short supply.

It would be foolhardy, at best, to provide funds for vessels of this sophistication without an effective training program and some effective operational control. This might take the form of a mandatory association of owners which required regular reporting and inspection.

Shrimp

A careful assessment of inshore stocks (0-20 miles) is imperative with shrimp industry development. This stock assessment can help determine the reasons for the catch rates now observed and their apparent fluctuation. Vessels of the type suggested earlier could be converted to shrimping if it proved desirable.

The particular purpose of this investigation would be to establish clear patterns of changes in abundance by seasons and areas within 20 miles, more or less, of the coast of Vietnam, particularly off the Delta and in the Gulf. It is esti-

mated that the cost of such a program would be $150,000 to $200,000 a year. A minimum of 1 year of intensive effort would be required, some 300 days at sea. This is a rigorous program indeed, but it is achievable.

Pelagic Fishery

Pelagic fish could account for the total increase of 150,000 M.T. While the pelagic resources could withstand this pressure, the process of locating and catching these stocks is complex. It should be recognized that the stocks exploited off shore might reduce near-shore production of the existing fleet. Vessels of the type suggested for trawling could, with a power block and seine roller and platform, fish for pelagic fish as well. As has been mentioned earlier, pelagic stocks tend to be highly seasonal, and it would be premature to invest money in vessels that are inflexible. Small purse seining boats would be necessary adjuncts of this experiment.

Prior to any investment in purse seine gear, a careful aerial reconaissance is recommended. This survey should be conducted on broad transects at first, and subsequently narrowed when shoals are sighted. It is hoped that the military aerial reconaissance capability could be used under the direction of the Directorate of Fisheries.

Among the major difficulties in offshore pelagic fishing is that of locating shoals of fish. It has been estimated that over 80 percent of the time at sea is spent hunting, and that, in some fisheries, 40 percent of the sets made caught no fish. It is well known that aircraft have been profitably used to reduce search time in pelagic fishing. The problem is ameliorated somewhat if a large number of vessels are at sea reporting on fish locations. This requires a large investment prior to exploitation, but, should purse seining develop, communication among vessels will be necessary for efficient national operations.

About $300,000 should be invested in air reconaissance and exploratory fishing in the Gulf and off the Delta during the next year. Vessels currently fishing could be chartered and modified for the work.

PROJECTION OF 850,000 M.T. BY 1980

An increase of 250,000 M.T. in production appears near the maximum technically achievable. It could press the available stock to sustain this rate.

Achieving such production is likely to be beyond economic feasibility anyway, unless some dramatic developments take place. Were the pelagic fishing to develop more rapidly than expected, this potential could be reached. Otherwise, the limit of about 150,000 M.T. estimated earlier would seem controlling. To produce 950,000 M.T. by 1980 would require a more rapid growth in vessel numbers (say 1,500) than would be feasible in the 6 years remaining and given necessary planning horizons and crew requirements.

It should be again noted that, while it is technically feasible to catch more fish than estimated, say even more than 250,000 M.T., this would be at the expense of depleting stocks in some cases and of unprofitable operations in others.

APPENDIX A--PROJECTIONS OF VIETNAMESE DOMESTIC FISH UTILIZATION TO 1980

Three models were developed to estimate Vietnam's total domestic utilization needs for fish, on a live weight basis, by 1980. Actual data, as reported by various government agencies, for the years 1960 through 1971 were incorporated into the functions. The functions have been designated as conservative, average, and optimistic. The specification of the variables used, the nature of the models chosen, and the resulting functions are presented below.

CONSERVATIVE MODEL

The structural form of the model is as follows:

$$\text{Demand:} \quad TU = a_o + a_1P + a_2Y + a_3N + a_4PP + e_1$$

$$\text{Supply:} \quad L = b_o + b_1P + b_2W + e_2$$

$$\text{Net Exports:} \quad NETX = c_o + c_1P + c_2W_{-1} + c_3T + e_3$$

$$\text{Equilibrium:} \quad NETX = L - TU$$

TU = Total domestic utilization of fish products per year, live weight basis, in metric tons.
L = Total domestic catch of fish per year, live weight basis, in metric tons.
P = Saigon average wholesale price of fish, in 1960 VN$/kg.
Y = Vietnamese per capita GNP, in 1960 VN$.
N = Population of Vietnam, in millions of persons.
PP = Saigon average wholesale price of pork, in 1960 VN$/kg.
W = Dummy variable for war, or level of hostilities, lagged one year in the net exports equation.
T = Time.

a_o, b_o and c_o are constants, while e_1, e_2 and e_3 are error terms.

Since a major purpose for constructing this model is the forecasting of the endogenous variables, the model was transformed into reduced form. This results in the specification of the four endogenous variables (TU, L, NETX, and P) as functions of seven predetermined variables (Y, N, PP, W, W_{-1}, T, and a constant).

In matrix notation, the reduced form is:

$$\begin{bmatrix} TU \\ L \\ NETX \\ P \end{bmatrix} = \begin{bmatrix} Y & N & PP & W & W_{-1} & T & 1 \end{bmatrix} \cdot G + N$$

The reduced form coefficients, the elements of the matrix G, are thus algebraic combinations of the structural coefficients. Since the equations are over-identified, this approach is likely to yield more reliable predictions than indirect least squares. The actual values of these coefficients calculated from regression are shown below.

1. The demand equation:

$$
\begin{array}{lccccc}
TU = & -799217 & -\ 4988.18P & +\ 33.9255Y & +\ 60589.8N & +\ 7663.01PP \\
 & (-3.26)^{*} & (-.984)^{*} & (1.34)^{*} & (4.24)^{*} & (1.15)^{*} \\
 & .98^{**} & .65^{**} & .75^{**} & .99^{**} & .70^{**}
\end{array}
$$

$R^2 = .92$ D.W. = 2.06 $F(4,7) = 19.43$

2. The supply equation:

$$
\begin{array}{lccc}
L = & -105842 & +\ 12871.0P & =\ 18141.8W \\
 & (-1.12)^{*} & (5.53)^{*} & (-3.04)^{*} \\
 & .70^{**} & .99^{**} & .98^{**}
\end{array}
$$

$R^2 = .72$ D.W. = 1.96 $F(2,9) = 11.33$

3. The exports equation:

$$
\begin{array}{lcccc}
NETX = & 25235.4 & -\ 850.741P & -\ 633.967W_{-1} & +\ 1799.88T \\
 & (1.69)^{*} & (-1.65)^{*} & (-.947)^{*} & (1.71)^{*} \\
 & .85^{**} & .85^{**} & .63^{**} & .85^{**}
\end{array}
$$

$R^2 = .77$ D.W. = 2.01 $F(3,7) = 7.99$

*T-statistic.
**Level of statistical significance.

The sources of all data except the dummy war variable are from official Republic of Vietnam Government publications.26/ The dummy war variable was constructed as a weighted average of two indicators of the level of hostilities: one indicator is the number of U.S. fatalities per year; the other is an indicator of the presence of government curfew and boundary restrictions. The number of U.S. military fatalities per year was transformed into a scale from 0 to 10, with 10 being the most casualties (1968). The government restrictions indicator was assigned 0 in years when restrictions were few, and 10 when restrictions were many (1965-68). Weighing each of these indicators by .5 and combining them yielded the war dummy variable used in the analysis. These data are presented in appendix table A-1.

26/ The data are reported in detail in Agriculture in the Vietnam Economy: A System for Economic Analysis, FDD Field Report 32, Economic Research Service, U.S. Department of Agriculture, cooperating with U.S. Agency for International Development, June 1973.

Appendix Table A-1--Data used in analysis of total domestic utilization of fish products in the Republic of Vietnam, 1960-1971

Year	Total utilization	Total landings	Net fish exports	Average wholesale fish price: Saigon	Yearly per capita GNP	Population	Average wholesale pork price: Saigon	Dummy war variable	Time
	- - - Metric tons - - -			1960 VN$/kg.	1960 VN$	Millions	1960 VN$/kg.		
1960....	262,502	262,915	413	30.96	5,823	14.07	24.16	0	1
1961....	303,682	304,315	633	31.78	5,638	14.49	24.10	0	2
1962....	331,488	332,215	727	33.42	6,255	14.28	27.46	0	3
1963....	364,010	364,873	863	39.38	6,369	14.13	34.12	0	4
1964....	396,151	397,015	864	37.88	6,898	14.36	29.48	.5	5
1965....	374,191	375,015	824	38.10	7,188	15.02	33.63	5.5	6
1966....	381,049	380,544	-505	48.47	7,180	15.11	32.47	6.7	7
1967....	411,464	410,740	-724	46.52	6,807	16.26	36.26	8.2	8
1968....	423,452	407,080	-16,372	59.41	6,506	16.26	43.43	10.0	9
1969....	478,724	463,844	-14,880	55.61	7,225	16.54	38.70	3.2	10
1970....	578,866	577,450	-1,416	54.27	7,074	17.33	41.91	1.5	11
1971....	586,270	587,500	1,230	51.63	6,027	18.70	39.29	.5	12

Source: Agriculture in the Vietnam Economy: A System for Economic Analysis, FDD Field Report No. 32, Economic Research Service, U.S. Department of Agriculture, cooperating with U.S. Agency for International Development.

A further word on the methodology used is appropriate here. The structural form of the model was estimated using two-stage least squares. This technique was chosen in place of a full information technique (such as three-stage least squares or maximum likelihood estimation) for two reasons. First, the sample size (12) was too small for a full information technique to be practical. Second, the cost in terms of time and difficulty of using full information estimation was prohibitive. As a result, estimation corrected for the correlation between residuals and the right-hand-side endogenous variables in each equation, but did not correct for interequation covariance of the residuals.

In order to project with this model, forecasts of the exogenous variables are necessary. The procedure used to obtain these forecasts was to perform simple ordinary least squares regression of each of the exogenous variables as a function of time, and then to project these variables into the desired time period using the coefficients of this ordinary least squares regression. This method is certainly one of the most elementary possible, and it is probable that more sophisticated estimates from other sources would yield more reliable results.

Appendix table A-2 shows these projected values of the exogenous variables. The projections of the W, W_{-1}, and T variables are trivial if we assume that, in the future, the level of hostilities will be so low as to have no effect on the fishing industry. The alternative projections for population and pork price are presented in order to demonstrate the effect of varying growth rates of these exogenous variables on the projections of the endogenous variables.

NF1 represents the projections resulting from a semi-logarithmic (constant proportional growth rate) estimating equation, where population is projected to grow at a constant 2.4 percent per year through 1980. NF2, on the other hand, represents projections based on a linear (constant absolute growth rate) estimating equation. This form yields a slightly smaller value for 1980 than does NF1. PPF1 also represents the result of estimating with a strictly linear functional form. Finally, PPF2 is based on a declining absolute growth rate projection, where pork price is formulated as a function of the square root of time. All this is clearer when presented mathematically:

YF:		$Y = 6074.27 + 78.1888T$
NF1:	log	$N = 2.58417 + .0239487T$
NF2:		$N = 13.0742 + .380245T$
PPF1:		$PP = 23.0433 + 1.64731T$
PPF2:		$PP = 15.0731 + 7.66293\sqrt{T}$

Given the projected values of the exogenous variables presented in appendix table A-2, and the calculated matrix of reduced form coefficients shown in appendix table A-3, it is possible to forecast the endogenous variables. Two forecasts were made, presenting estimates under the alternative assumptions concerning rate of growth of population and pork price, as discussed previously. These forecasts are presented in appendix table A-4.

Appendix table A-2--Projections of exogenous variables, total domestic fish utilization projection, Republic of Vietnam, conservative model, 1960-1980

Year	Per capita GNP	Population		Pork price		War dummy	Time
	1960 VN$	- - Millions - -		- - 1960 VN$/kg - -			
Variable Name	YF	NF1	NF2	PPF1	PPF2	W	T
1960	6,152	13.57	13.45	24.69	22.74	0	1
1961	6,231	13.90	13.83	26.34	25.91	0	2
1962	6,309	14.24	14.22	27.99	28.35	0	3
1963	6,387	14.58	14.60	29.63	30.40	0	4
1964	6,465	14.94	14.98	31.28	32.21	.5	5
1965	6,543	15.30	15.36	32.93	33.84	5.5	6
1966	6,622	15.67	15.74	34.57	35.35	6.7	7
1967	6,700	16.05	16.12	36.22	36.75	8.2	8
1968	6,778	16.44	16.50	37.87	38.06	10.0	9
1969	6,856	16.84	16.88	39.52	39.31	3.2	10
1970	6,934	17.25	17.26	41.16	40.49	1.5	11
1971	7,013	17.66	17.64	42.81	41.62	.5	12
1972	7,091	18.09	18.02	44.46	42.70	0	13
1973	7,169	18.53	18.40	46.11	43.75	0	14
1974	7,247	18.98	18.78	47.75	44.75	0	15
1975	7,325	19.44	19.16	49.40	45.72	0	16
1976	7,403	19.91	19.54	51.05	46.67	0	17
1977	7,482	20.39	19.92	52.69	47.58	0	18
1978	7,560	20.89	20.30	54.34	48.48	0	19
1979	7,638	21.39	20.68	55.99	49.34	0	20
1980	7,716	21.91	21.06	57.64	50.19	0	21

Appendix table A-3--Matrix of reduced form coefficients, total domestic fish utilization projection, Republic of Vietnam, conservative model

G =	24.8808	23.3383	-1.54259	.00181324
	44436.2	41681.2	-2755.02	3.23838
	5620.00	5271.57	-348.437	.409569
	-4836.72	-5661.62	-824.908	.969635
	169.019	-436.121	-605.140	-.033884
	-479.859	1238.18	1718.04	.0961992
	-621087	-565471	55615.7	-34.7104

Appendix table A-4--Forecasted values of endogenous variables, total domestic fish utilization, Republic of Vietnam, conservative model

Year	Forecast							
	Total utilization of fish		Fish landings		Net exports of fish		Average Saigon wholesale price of fish	
	Alternative							
	1	2	1	2	1	2	1	2
	Thousands of metric tons						1960 VN$/kg	
1974...	663.8	637.9	665.1	640.8	1.3	2.9	59.9	58.0
1975...	695.0	661.8	696.0	664.9	1.0	3.1	62.3	59.9
1976...	726.6	685.4	727.3	688.7	0.7	3.3	64.7	61.7
1977...	758.6	709.0	759.1	712.5	0.5	3.5	67.2	63.6
1978...	791.6	732.3	791.7	736.1	0.1	3.8	69.7	65.4
1979...	824.5	755.6	824.3	759.6	-0.2	4.0	72.3	67.2
1980...	858.4	778.7	857.7	783.0	-0.7	4.3	74.9	69.1

Evaluation of the Conservative Model Forecasts

All of the estimated coefficients in the demand equation are of the sign predicted by theory, and are generally of reasonable magnitude, although the income coefficient is quite low relative to those of the other variables. Only two of the right-hand-side variables are highly significant (population and the constant term), and the price coefficient is the least significant. The reason for this may lie in the fact that the prices represent averages for a number of fish products. The low significance level and small coefficient of income may be due to the tremendous fluctuations in GNP caused by the vast and sudden inflow of American dollars. The Durbin-Watson statistic is very nearly two, indicating the probable absence of serial correlation. The F-statistic is highly significant.

As was the case with the demand equation, all of the coefficients in the supply equation are of the expected sign. In addition, the coefficients of both price and the hostilities dummy are highly significant. The Durbin-Watson statistic suggests the absence of serial correlation, and the F-statistic is again highly significant. The calculated R^2 is much lower than that of the demand equation, but this is to be expected (partly due to the nature of two stage least squares estimation, and partly due to the fact that the supply equation contains fewer right-hand-side variables) and is of no concern.

As was the case with both previous equations, all the estimated coefficients of the net export equation have the signs predicted *a priori*. None of the coefficients is highly significant, but, as a whole, this equation appears to be as satisfactory as the demand equation. The relative significance of the price coefficient lends some support to the hypothesized influence of domestic price on trade flows. The Durbin-Watson statistic is again nearly two, and the F-statistic is significant at the 95 percent level, and almost at the 99 percent level. As was the case with the supply equation, the R^2 value of less than .80 is of little concern.

It was decided to adopt the more conservative of the forecast projections (forecast alternative 2) since the authors believe that gross national product and population growth in Vietnam will probably be at a slower rate between 1973 and 1980 than was true between 1965 and 1973. Therefore, the estimated values projected to 1980 are those shown in appendix table A-5.

AVERAGE MODEL

The projection of total domestic fish utilization needs to 1980 was 850,000 M.T. in the average model. This was based on a linear multiple regression analysis which showed the following:

$$\begin{array}{lllll} TU = -943 + & 2.78Y + & 84.05N - & 5.35P & \\ & (1.69) & (13.28) & (2.70) & \text{(Standard Errors)} \\ & \boxed{1.64} & \boxed{6.33} & \boxed{1.98} & \boxed{\text{T-statistics}} \end{array}$$

$R^2 = .93$

F-statistic = 37.71

where:

TU = Total utilization of fish, live weight basis, 1,000 M.T.;
Y = Gross national product, billion VN$ (1960);
P = Saigon average wholesale price of fish/kg, VN$ (1960);
N = Average annual population, million persons.

Appendix table A-5--Estimated values of independent and dependent variables, conservative model, Vietnam fish utilization and supply study, selected years, 1961-1980

Variable	Year				
	1961	1965	1970	1975	1980
1. Total domestic fish utilization, 1,000 M.T.	293.4	384.9	533.8	661.8	778.9
2. Total domestic fish landings, 1,000 M.T.	295.7	381.8	532.8	664.9	783.0
3. Net fish exports, 1,000 M.T.	2.3	-3.1	-1.2	3.1	4.3
4. Saigon average wholesale fish price, 1960, VN$/kg	31.2	45.6	51.7	59.9	69.1
5. Per capita GNP per year, 1960, VN$	6,231	6,543	6,834	7,325	7,716
6. Population, million	13.8	15.4	17.3	18.2	21.9
7. Saigon average wholesale pork price, 1960, VN$/kg	25.9	33.8	40.5	46.7	50.2

Based on the standard errors of the regression coefficients and their T-statistics, price and population were highly significant variables in explaining changes in total utilization in this model. Population was significant at more than the 99 percent probability level. Although income was only significant at the 90 percent level, it is also judged to be an important explanatory variable in this model.

A calculation of changes in per capita utilization from 1960 to 1980, based on the model projections, seems quite realistic when compared with data from similar countries such as Taiwan, Thailand, and Korea; per capita utilization increases from its 1960 base of approximately 21 kg per year to more than 40 by 1980, but the increase is at a decreasing rate, as logic would suggest. The estimated values for each of the variables for selected years are shown in appendix table A-6.

Appendix table A-6--Estimated values of independent variables regressed against total Vietnam fish utilization, average model, selected years, 1960 to 1980

Year	Total fish utilization	GNP	Average Saigon fish price	Population
	1,000 M.T.	Billion 1960 VN$	1960 VN$/kg	Million persons
1960	280	82.62	30.08	13.45
1965	422	100.67	42.69	15.36
1970	565	118.72	55.31	17.26
1975 1/	707	136.77	67.92	19.16
1980 1/	850	154.81	80.53	21.06

1/ Projected estimates.

OPTIMISTIC MODEL

The optimistic model projects a total domestic utilization need in 1980 of 938,162 M.T. of fish on a live weight basis. This was based on a curvilinear multiple regression analysis which showed the following:

$$\mathrm{LOG\ TU} = -2.060 + \underset{\substack{(.94)\\ \boxed{1.03}}}{.961\ \mathrm{LOG}\sqrt{Y}} + \underset{\substack{(1.19)\\ \boxed{3.64}}}{4.309\ \mathrm{LOG}\sqrt{N}} - \underset{\substack{(.29)\\ \boxed{.07}}}{.020\ \mathrm{LOG}\ P} \qquad \substack{\text{(Standard errors)}\\ \boxed{\text{T-statistics}}}$$

$R^2 = .89$
F-statistic = 22.61

Based on the standard errors of the regression coefficients and their T-statistics, only the population variable was highly significant in explaining changes in total utilization in the model. However, the T-statistic for the income variable was at the 90 percent level of probability. Although the price variable demonstrated the proper inverse relationship with total utilization, its influence in the model was extremely small.

The relatively high correlation coefficient (.94), the highly significant F-statistic (22.61), and particularly the low standard error of estimate (.10) suggest that the model may properly express future domestic utilization under certain optimistic assumptions about the independent variables. Principal among these is that: 1) population growth will continue at the present rate, and is the major explanation for growth in aggregate utilization; 2) income also exerts an important upward force on utilization of fish; 3) the normal

inverse relationship between price and demand does not exert a significant dampening effect on utilization of fish in the future; and 4) per capita utilization continues to increase at a slightly increasing rate. This would imply that fish and fish products are superior goods in Vietnamese diets, and that little substitution takes place between fish and any other foods.

The latter may in fact be quite realistic since actual domestic per capita utilization has indeed increased at a rather rapid rate since 1960 despite a strong upward trend in real fish prices. Further, a per capita annual utilization of 44.5 kg by 1980 is not exceptionally high by Asian standards. For example, the Japanese per capita consumption of fish was more than 47 kg per year in 1965, and is expected to reach 73 kg per year by 1980. 27/

The estimated values for each of the variables for selected years are shown in appendix table A-7 below.

Appendix table A-7--Estimated values of independent variables regressed against total Vietnam fish utilization, optimistic model, selected years, 1960-1980

Year	Total fish utilization	Gross national product	Average Saigon fish prices	Population
	1,000 M.T.	Billion 1960 VN$	1960 VN$/kg	Million persons
1960	269	82.62	30.08	13.45
1965	391	100.67	42.69	15.36
1970	541	118.72	55.31	17.26
1975 1/	723	136.77	67.92	19.16
1980 1/	938	154.81	80.53	21.06

1/ Projected estimates.

27/ Export Opportunities For Selected Vietnam Fish Products in Japan, FDD Field Report 43, USDA/ERS, cooperating with USAID, January 1974, figure 2.